

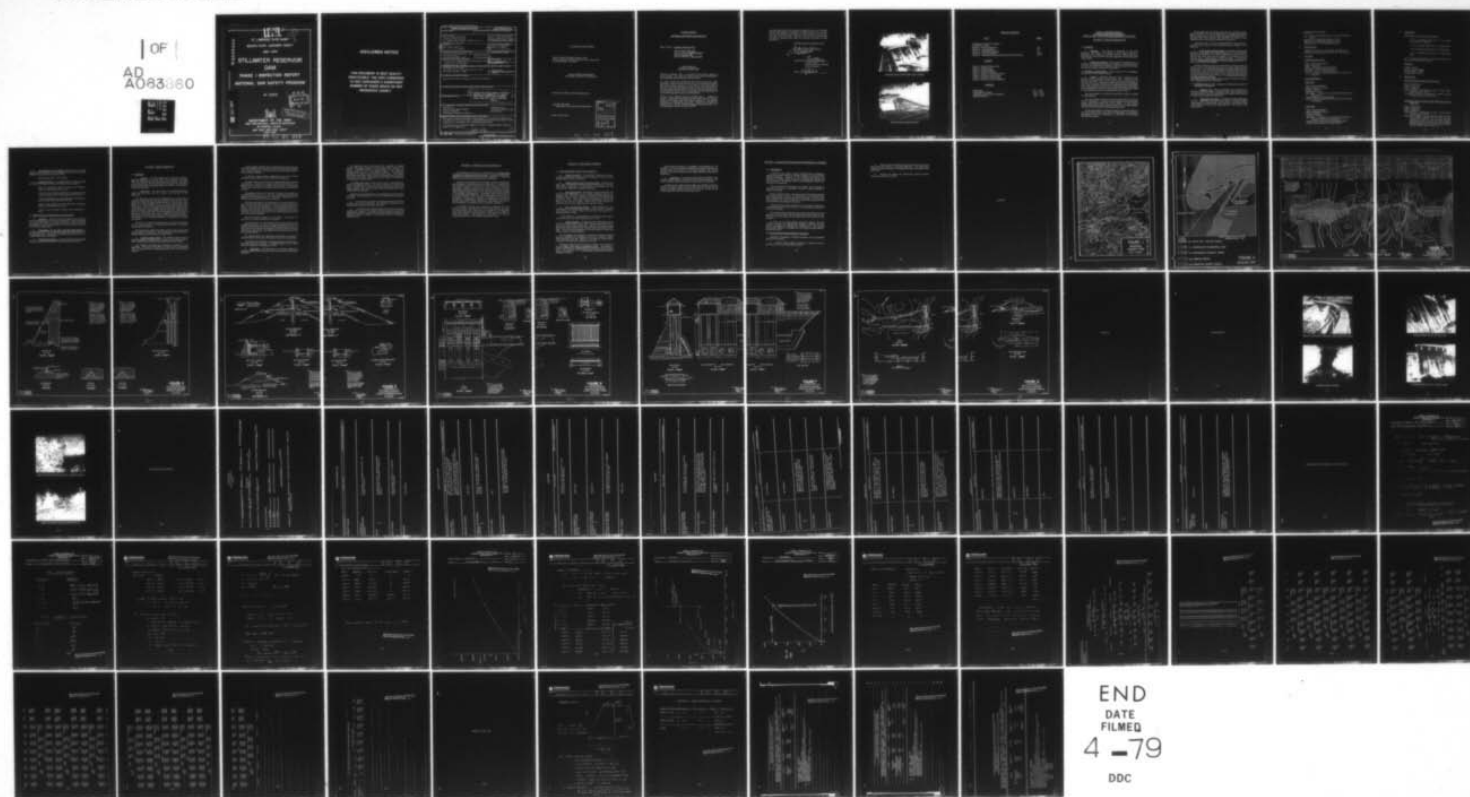
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NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/6 13/2
NATIONAL DAM SAFETY PROGRAM. STILLWATER RESERVOIR DAM (NY00316)--ETC(U)
SEP 78 J J WILLIAMS DACW51-78-C-0035

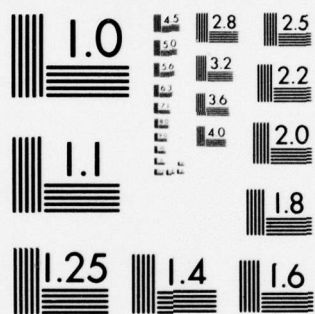
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ST. LAWRENCE RIVER BASIN

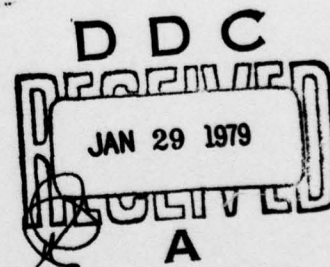
BEAVER RIVER. HERKIMER COUNTY

NEW YORK

STILLWATER RESERVOIR DAM

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

NY 00316



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NEW YORK DISTRICT, CORPS OF ENGINEERS
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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7. AUTHOR(s) (10) John J. Williams P.E.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien and Gere Engineers, Inc. ✓ 1301 Buckley Road Syracuse, New York 13221		8. CONTRACT OR GRANT NUMBER(s) (15) DACW51-78-C-0035
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety National Dam Safety Program Visual Inspection Hydrology, Structural Stability Herkimer County Stillwater Reservoir Dam Beaver River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization. Stillwater Reservoir Dam was judged to be safe, although further stability analysis was suggested. 393 970 <i>elt</i>		

ST LAWRENCE RIVER BASIN

Name of Dam: Stillwater Reservoir Dam
County and State: Herkimer County, State of New York
Inventory Number: NY 00316

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by: O'Brien and Gere Engineers, Inc.

For: New York State
Department of Environmental Conservation

Date: July 13, 1978

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Stillwater Reservoir Dam

State Located: New York

County Located: Herkimer County

Stream: Beaver River

Date of Inspection: June 13, 1978

ASSESSMENT OF
GENERAL CONDITIONS

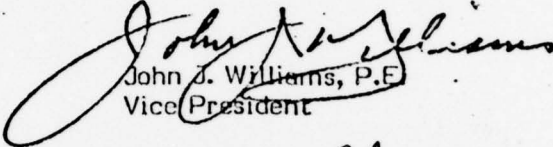
Stillwater Reservoir Dam is constructed across three valleys of various depths. The valleys are closed by two earthen embankments and a concrete spillway and non-overflow section.

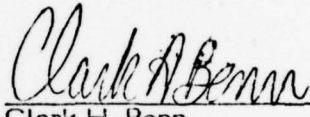
No serious structural deficiencies were noted during the visual inspection. Pools of water were located on the downstream slopes of both earthen dams; however, no movement in the pools could be detected. Also, the downstream slopes of both dams and portions of the upstream slope and crest of the north dam were covered with trees and brush. Removal of this vegetation and the maintenance of a controlled vegetation cover are recommended.

Review of the stability analyses indicates that the resultant is located a significant distance outside the middle third of the base width for the normal and PMF loading conditions. The analyses considered a simple gravity structure. However, the structure is arched in plan. Further stability analyses evaluating the dam as an arched/gravity structure are recommended.

The discharge facilities are capable of passing 86 per cent of the PMF without overtopping the earthen non-overflow sections. The concrete non-overflow section is overtopped for floods exceeding approximately 30 per cent of the PMF. The flood crest elevation resulting from the PMF is approximately 1,688; the maximum discharge is about 40,770 cfs.

O'BRIEN & GERE ENGINEERS, INC.


John J. Williams, P.E.
Vice President

Approved by: 
Clark H. Benn
Colonel, Corps of Engineers
District Engineer

Date: 21 September 78



CONCRETE SPILLWAY AND GATE HOUSE



SOUTH DAM LOOKING SOUTH

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM STILLWATER RESERVOIR DAM ID# NY 00316

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #1467-021 between O'Brien and Gere Engineers, Inc. and the New York State Department of Environmental Conservation.

b. Purpose of Inspection - The purpose of this inspection is to evaluate the structural and hydraulic condition of Stillwater Reservoir Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 PROJECT DESCRIPTION (From drawings and information provided by NYSDEC and HR-BRRD)

a. General - Stillwater Reservoir Dam is located on the Beaver River in Herkimer County, New York, about $3\frac{1}{2}$ miles upstream of Moshier Dam and 24 miles east of the community of Lowville, New York. The dam is owned and operated by the State of New York, Hudson River-Black River Regulating District (HR-BRRD) and is used to regulate river flows for flood control and downstream power development. The dam was initially constructed around 1885; it was enlarged and raised to its present elevation in 1924.

The dam complex is constructed across three valleys or ravines of various depths.

The north valley is closed by an earth embankment (north dam) which is connected to a concrete gravity spillway and non-overflow section constructed across the center valley. A rock outcrop separates the concrete non-overflow section from the earth embankment (south dam) constructed across the south valley.

Normal discharges are released through four openings located in the non-overflow section upon which the gatehouse is constructed. Discharges through the openings are controlled with manually operated sluice gates.

Uncontrolled flood discharges pass over the concrete gravity spillway located in the center valley and an emergency spillway and channel constructed in the rock abutment about 1,000 feet south of the south dam. Both spillway crest elevations are raised by wood flashboards which are manually positioned and removed.

A sluiceway used to remove floating debris from the reservoir is located on the north end of the concrete spillway adjacent to the north dam.

b. Size and Hazard Classification - According to information provided by the New York State Department of Environmental Conservation (NYSDEC), the maximum height of the dam is about 55 feet (at the north dam) and the volume of the reservoir to the spillway crest is approximately 103,000 acre-feet. In accordance with the Recommended Guidelines for Safety Inspection of Dams, the dam is in the large size category.

Stillwater Reservoir Dam is located about $3\frac{1}{2}$ miles upstream of Moshier Dam, a power generating site for Niagara Mohawk Power Corporation. Some residential development is located downstream of Moshier Dam. Loss of life and damage to property could be expected if Stillwater Reservoir Dam were to fail. Therefore, the dam is in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

Accordingly, the spillway design flood required for hydraulic analysis is the Probable Maximum Flood (PMF).

1.3 PERTINENT DATA (from drawings and information provided by NYSDEC and HR-BRRD)

a. Drainage Area - The total drainage area contributing to Stillwater Reservoir is about 178 square miles. The majority of the drainage area is covered by mountain forest underlain predominantly by glacial granular deposits and bedrock.

b. Discharges at Damsite - The average annual discharge is 372 cfs. Discharges are varied daily based on recorded rainfall measurements and downstream water demand. The State of New York requires a minimum daily discharge of 50 cfs for river flow augmentation.

c. Elevation (feet above MSL)

Top of earth dam embankments (north and south dam) - 1687.3

Spillway crest (flashboards in place) - 1679.3

Spillway crest (flashboards removed) - 1677.3

Sluiceway Crest - 1674.3 (stoplogs removed)

d. Reservoir Data

Storage at spillway crest (el. 1679.3) - 103,300 ac.ft.

Surface area at spillway crest (el. 1679.3) - 10.5 sq.miles

e. Dam Data

Concrete Gravity Section

Type - concrete gravity/arch

Length - 320+ feet

Height - 40+ feet (non-overflow section)

Top Width - 8 feet at spillway section

Top width - 9½ feet at gatehouse section

Slopes - upstream - vertical, downstream - 2 vertical to 1 horizontal

Earth Embankments

South Dam

Type - earth embankment

Maximum Height - 22+ feet

Length - 300+ feet

Top width - 15+ feet

Side Slopes - 1 vertical to 2 horizontal (upstream and downstream)

Impervious Core - selected material

Cutoff - Selected material placed to a depth as ordered by the Engineer.

North Dam

Type - earth embankment

Maximum Height - 55+ feet

Length - 600+ feet

Top width - 15+ feet

Side Slopes - 1 vertical to 2 horizontal (downstream) - 1 vertical to 2½ horizontal (upstream)

Imperious Core - concrete core to elevation 1683.3

Cutoff - No information was made available.

f. Outlet Data

Non-overflow section (four gated opening)

1 - 5' x 2' opening, fitted with 2 - 2' x 2' sluice gates with a 12" separator.

1 - 3' x 3' opening, fitted with a 3' x 3' sluice gate.

1 - 4' x 5' opening, fitted with a 4' x 4' sluice gate

1 - 4' x 5' opening, fitted with a 4' x 3'10" sluice gate

A 5' x 4' stoplog assembly is available for placement in any one of the four water passages.

Sluiceway

Length - 10 feet

Gates - wooden stoplogs

Crest Elevation - 1674.3

Top Elevation - 1683.3 ±

g. Spillway Data

Spillway located in concrete gravity section

Type - concrete weir

Length - 245+ feet

Gates - flashboards

Crest Elevation - flashboards in place - 1679.3, flashboards removed - 1677.3

Downstream Channel the downstream channel is formed in natural massive rock outcrops

Emergency spillway located about 1,000 feet south of South Dam

Type - concrete weir

Length - 200+ feet

Gates - flashboards

Crest Elevation - flashboards in place - 1679.3, flashboards removed - 1677.3

Downstream Channel - the downstream channel converges and flashboard leakage and low flows are discharged into three 21 inch diameter culverts constructed under a service road. The emergency spillway channel outlet to the river below the south dam is through a natural swamp area.

h. Flood Elevations at the Dam (Local Datum) - The flood elevation was computed for the Probable Maximum Flood with the flashboards in place (crest elevation 1679.3)

PMF Elevation (MSL - feet) - 1685.0

i. Engineering Data - The engineering data made available by NYSDEC for review of Stillwater Reservoir Dam included:

-Set of construction plans (9 sheets) for Stillwater Reservoir, dated September 22, 1923.

-Copy of "Dam Report" published by the State of New York Conservation Commission, dated August 29, 1917.

-Copy of "Application for the Construcion or Reconstruc-tion of a Dam", dated November 26, 1924.

-Copy of Dam Report from the Blackwater Regulating District, dated September 2, 1924.

-Copy of Dam Inspection Report, dated September 1, 1971.

1.4 OPERATING AND MAINTENANCE PROCEDURES

a. Operation - The dam is used to regulate river flows for flood control and downstream power development. Normal discharges are varied daily based on recorded rainfall and power generating requirements. New York State requires a minimum release of 50 cfs for river flow augmentation.

b. Maintenance of the Dam and Operating Facilities - Maintenance of the dam and operating facilities is performed on an "as required" basis. According to operating personnel, the dam is visually inspected on a daily basis.

c. Flood Warning System - A flood warning system operated through the facilities of local Civil Defense Offices is in effect.

SECTION 2 - VISUAL INSPECTION

2.1 FINDINGS

a. General - The field inspection for Stillwater Reservoir Dam was conducted on June 13, 1978. The temperature was about 50°F with overcast skies and light intermittent showers. The water surface elevation at the time of inspection was about one foot below the top of the flashboards (approximately el. 1678.3). No underwater areas were inspected.

b. South Dam - The south dam is an earthen embankment about 300 feet long, tied into massive rock outcrops at both abutments.

The downstream slope of the embankment is covered with a relatively dense growth of trees and brush for its entire length. Some riprap was noted interspaced along the slope. Pools of water were observed at three locations at the toe of the downstream slope, however, no movement which would indicate flow was detected in any of the pools. The upstream slope of the embankment is surfaced with riprap consisting of semi-angular granitic type rock weighing from about 75 to 300 pounds each. The riprap protection extends about six feet above the present water level. Vegetation along this slope is limited to a few small trees and brush. The embankment appears to be straight and no noticeable indications of settlement or erosion were noted.

The crest of the spillway located south of the South Dam appears to be in good condition. No significant indications of structural deterioration are apparent.

The downstream channel converges in plan and is covered with native grasses and vegetation. The area adjacent to either side of the spillway channel is well forested with large trees.

c. Concrete Gravity Dam - The concrete gravity dam is located between two massive rock outcrops and is curved upstream in plan. A gatehouse and spillway are constructed along its length.

Five manually controlled gate operators are located in the gatehouse. The gates are positioned by hoists which are operated from a common electric motor driven power shaft with individual clutches.

A steel stoplog assembly which can be placed in any of the four discharge openings is stored in the gatehouse. All equipment appears to be in good condition. According to the gatehouse superintendent, all the hoists are operable.

A reservoir stage recorder established by the United States Geological Survey (USGS) is also located in the gatehouse.

The downstream face of the non-overflow section shows signs of deterioration. A protective surface treatment (gunite) which was applied to the structure has weathered and cracked. Some spalling of the gunite was noted in the downstream slope of the non-overflow section.

The spillway is about 250 feet long. At time of the inspection, the flashboards were in place. They are individually secured by pins placed at intervals along the crest. Some minor leakage through the flashboards was observed during the inspection.

The concrete along the crest appears to be in good condition. A small crack in the surface, running parallel to the crest was located about 75 feet from the gatehouse. It is apparently superficial, no relative movement could be detected. The construction joints on the upstream side are open. No deterioration was observed in the joints. The joints on the downstream side are well maintained and have been filled with a sealer material.

The crest alignment appears to be excellent. No indication of horizontal or vertical movement was noticeable.

The downstream face of the spillway has also been surfaced with a protective material. A much more significant deterioration of the material than observed on the non-overflow section was evident. In areas where the material had dislodged from the structure, spalled concrete was again noted. No seepage was observed in the toe area of the gravity section.

The channel below the gatehouse and spillway is formed in natural massive rock outcrops. No erosion of the rock was observed.

A log sluiceway fitted with a stoplog assembly is constructed on the north side of the spillway. The stoplog assembly was in place during the inspection, no leakage was noted.

c. North Dam - The north dam is an earthen embankment extending about 600 feet from the concrete gravity dam to the north abutment.

The upstream slope is protected with a blanket of dumped granitic type riprap, ranging in nominal sizes from 4 inches to 24 inches. A significant growth of small sapling trees and brush are located along the crest and upstream slope. No significant settlement or erosion were observed along crest. Two capped galvanized metal pipes about two inches in diameter were located in the center of the crest. Operating personnel indicated no knowledge of these pipes or their function.

The downstream slope is well covered with a dense growth of large trees (diameter range in size from 3 inches to 12 inches) and brush. A small pool of water was located just downstream of the right abutment. The water was clear and no movement which might indicate flow was detected.

Backwater from the Beaver River was observed at the toe of the north dam. The embankment in this area is protected with a blanket of riprap.

d. The reservoir is bordered by property owned by the State of New York and is uninhabited. No indication of slope failure or bank erosion was noted in the areas observed.

e. The downstream channel appears to be formed in natural massive rock outcrops. The adjacent banks are heavily wooded and uninhabited. Moshier Dam is located about $3\frac{1}{2}$ miles downstream; the reservoir formed at Moshier Dam extends almost to Stillwater Reservoir Dam.

SECTION 3 - HYDROLOGY AND HYDRAULICS

In accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams, the spillway design flood required for evaluation of the hydraulic capabilities of Stillwater Reservoir Dam is the Probable Maximum Flood (PMF).

The PMF was calculated from probable maximum precipitation data published in Hydrometeorological Report No. 33. Rainfall data was modified to account for basin size, storm patterns and duration. The HEC-I computer program was used to develop the inflow hydrograph and flood route the PMF through the reservoir facility. Peak inflow and outflow rates for the PMF were calculated as 90,400 cfs and 40,800 cfs respectively. The spillway capacity was computed to be approximately 33,200 cfs. Peak inflow and outflow rates for one-half of the PMF were calculated as 45,200 cfs and 17,400 cfs respectively. The spillway is capable of discharging an inflow of 86 per cent of the PMF without overtopping. According to ETL 1110-2-234, the spillway is inadequate, but not "seriously inadequate."

A drawdown analysis was performed to estimate the time required to drain the reservoir. The four gated openings were used for the reservoir drain and inflow was assumed to be negligible. Under these conditions, approximately 45 days would be required to drain the reservoir. This represents a minimum time with no consideration given to safe discharge velocities or flows.

SECTION 4 - STRUCTURAL STABILITY

4.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation - No significant indications of structural deficiencies were noted during the inspection of the south dam, concrete gravity dam or north dam.

b. Design, Reports and Construction Data - Drawings and data relative to Stillwater Reservoir Dam were provided by the New York State, Department of Environmental Conservation and the Hudson River - Black River Regulating District.

c. Operating Records - According to records published by the United States Department of the Interior, Geological Survey, the maximum water elevation recorded at Stillwater Reservoir Dam is 1680.08 on May 20, 1969. The period of record is from 1908 through the current year. According to operating personnel, ice does not form at the concrete gravity section due to the influence of relatively warmer water rising from the reservoir bottom.

d. Post Construction Changes - Data pertaining to the construction of the original dam was not made available. Construction drawing and reports indicate that the dam was raised to its present elevation in 1924.

A dam inspection report published in 1971 states that a gunite cap was placed on the concrete gravity dam in 1969.

e. Seismic Stability - According to the Geologic Map of New York (Adirondack Sheet) dated 1970, Stillwater Reservoir Dam is founded on granitic-gneiss type rock. Massive rock outcrops were observed in both abutments of the concrete gravity dam and the south dam. The rock outcrops appear to be coarse grained in texture and display random fracturing patterns.

The geological map indicates a lineament, implying a faulted structure, paralleling the longitudinal axis of the reservoir terminating upstream of the dam. However, no evidence of seismic related stress was noted during the inspection of the dam.

Stillwater Reservoir Dam is located in seismic zone 3 as shown on the Seismic Zone Map of Contiguous States. Accordingly, a stability analysis was conducted using the coefficient associated with zone 3 as presented in the Recommended Guidelines for Safety Inspection of Dams.

Factual data pertaining to foundation investigations are not available. Therefore, design assumptions concerning foundation rock characteristics were based on information obtained from general geologic maps and field observations made during the course of the inspection.

f. Evaluation - The analyses of the structural stability of the concrete gravity spillway considered three loading conditions. The results of these loading conditions are summarized in the appendix.

A review of the results indicates that the resultant is located a significant distance outside of the middle third of the base for the normal and PMF loading conditions; the resultant of the seismic loading falls within the limits of the base width.

SECTION 5 - ASSESSMENT/RECOMMENDATIONS/REMEDIAL MEASURES

5.1 ASSESSMENT

A review of the stability analysis indicates that the spillway is structurally unstable relative to resultant location for normal and PMF loading conditions. However, in the analyses, the spillway was evaluated as a simple gravity structure; no consideration was given to the curvature of the spillway which could significantly improve the stability of the structure.

The north and south dams appear to be stable. The crests show no significant deviations in alignment; no signs of slope instability or erosion were noted.

Pools of standing water were located on the downstream slopes of both embankments, however, no discoloration or movement which might indicate flow could be detected in the pools. The pools may have resulted from surface runoff due to intermittent showers which occurred before and during the inspection.

The slopes of both dams and the crest of the north dam support an uncontrolled growth of trees and brush. No maintenance program for removal was evident.

The concrete surface protection has cracked and spalled in several places on the downstream face of the gravity structure. However, this condition does not appear to adversely affect the stability of the structure.

A review of the flood routing performed indicates that the discharge facilities are hydraulically capable of passing the PMF without overtopping the earthen dam embankments. The concrete non-overflow section is overtopped for all floods exceeding approximately the $\frac{1}{2}$ PMF.

5.2 RECOMMENDATIONS/REMEDIAL MEASURES

Additional investigation, remedial measures and recommended actions are as follows:

1. Perform further stability analyses to evaluate the curvature effect of the concrete gravity structure.

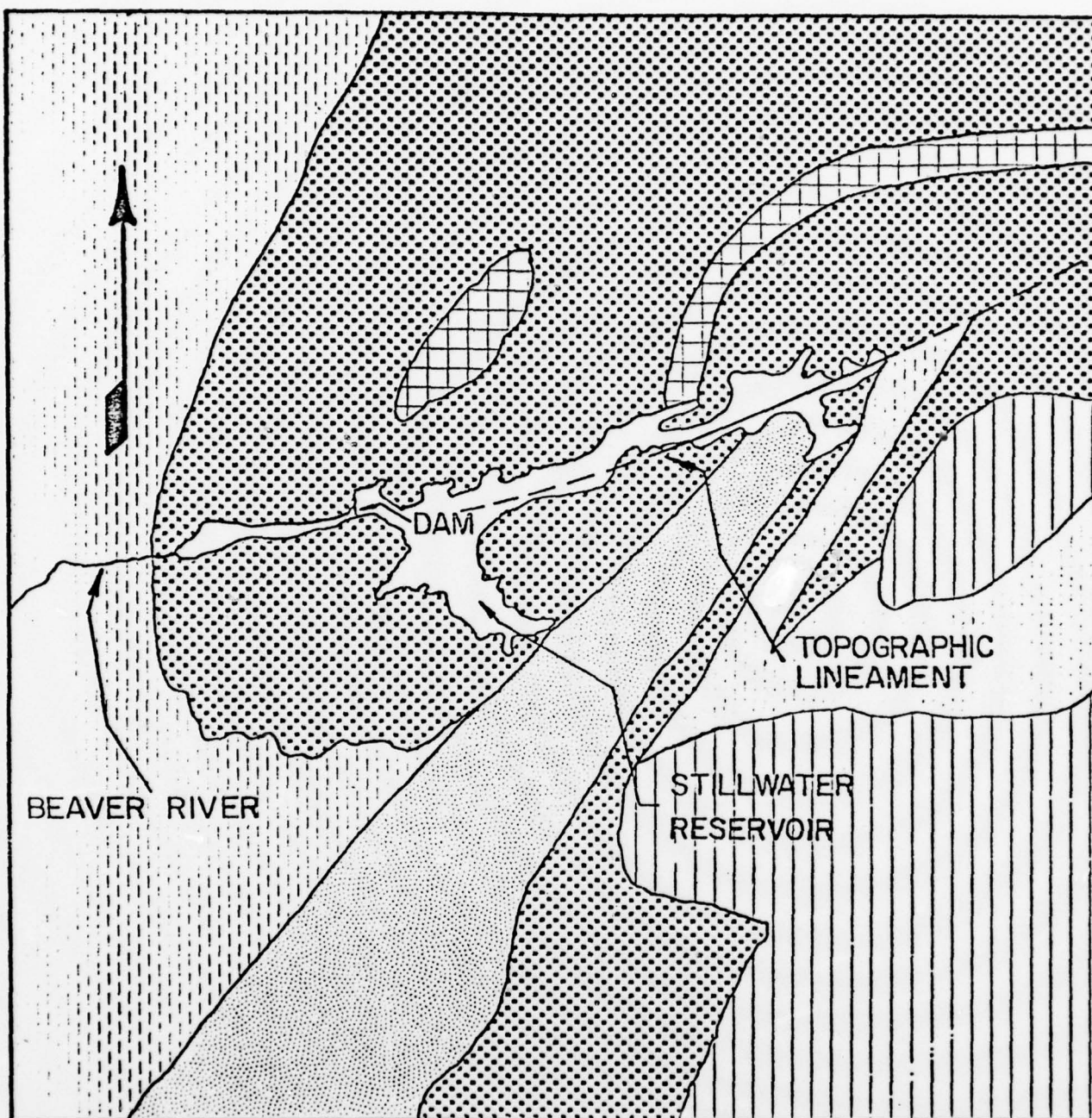
2. Remove trees and brush from the slopes and crests of the earth dams and maintain a controlled vegetation. This maintenance program should also pertain to the spillway located to the south of the south dam.

3. Remove and replace the deteriorated concrete surface protection material as required.

FIGURES



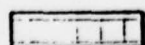
FIGURE I
REGIONAL
VICINITY MAP
SCALE 1:62500



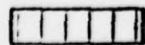
LEGEND



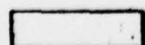
hbq · BLACK MICA AND/OR GRANITE



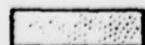
mu · FRAGMENTED METAMORPHIC ROCK



mug · FRAGMENTED GRANITE GNEISS



phgs · GRANITIC GNEISS

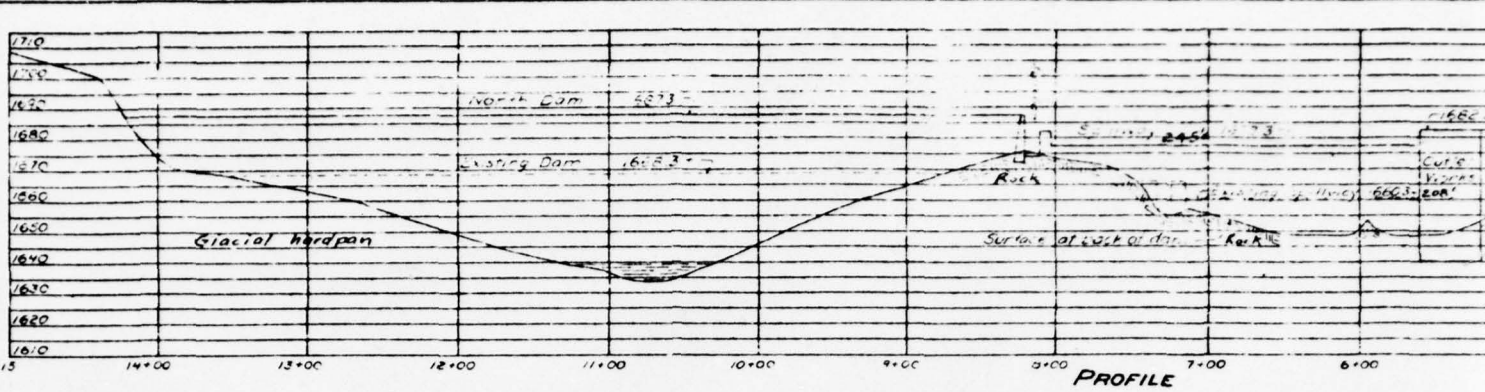


phqs · GRANULAR QUARTZ GNEISS

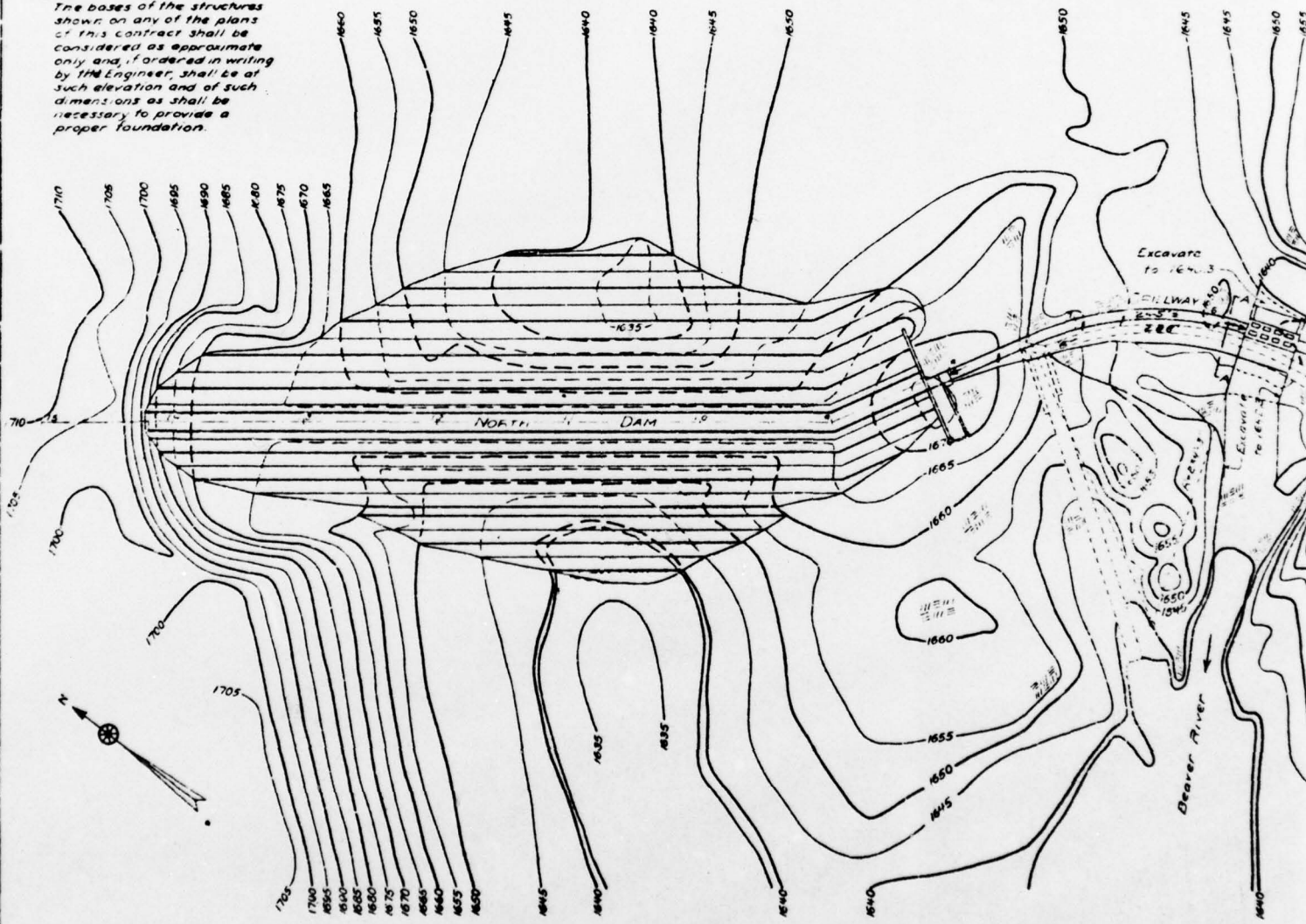
SOURCE · GEOLOGIC MAP OF NEW YORK
ADIRONDACK SHEET 1970

FIGURE 2
GEOLOGIC MAP

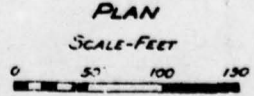
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Notes -
The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer, shall be of such elevation and of such dimensions as shall be necessary to provide a proper foundation.



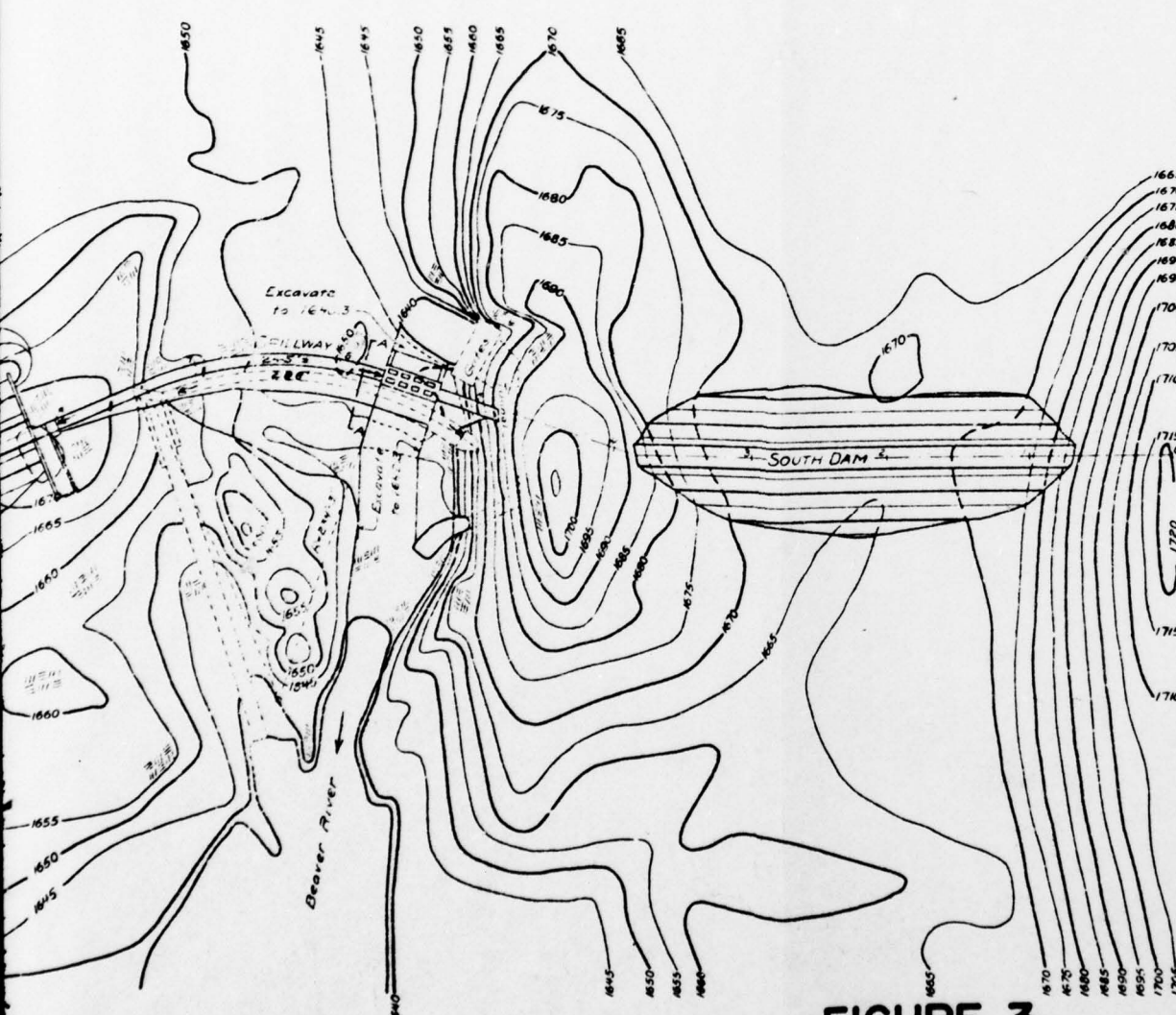
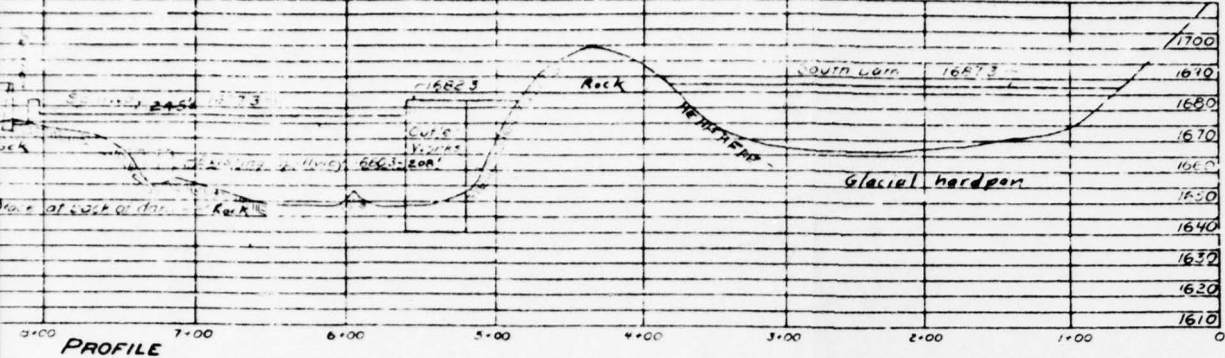
Ledge Rock indicated



Design by *William J. Johnson*
Asst. Engineer
Approved by *Charles E. Johnson*
Chief Engineer

Approved by *John M. Johnson*
Chief Engineer

SHEET 9



PLAN
SCALE-Feet
50 100 150

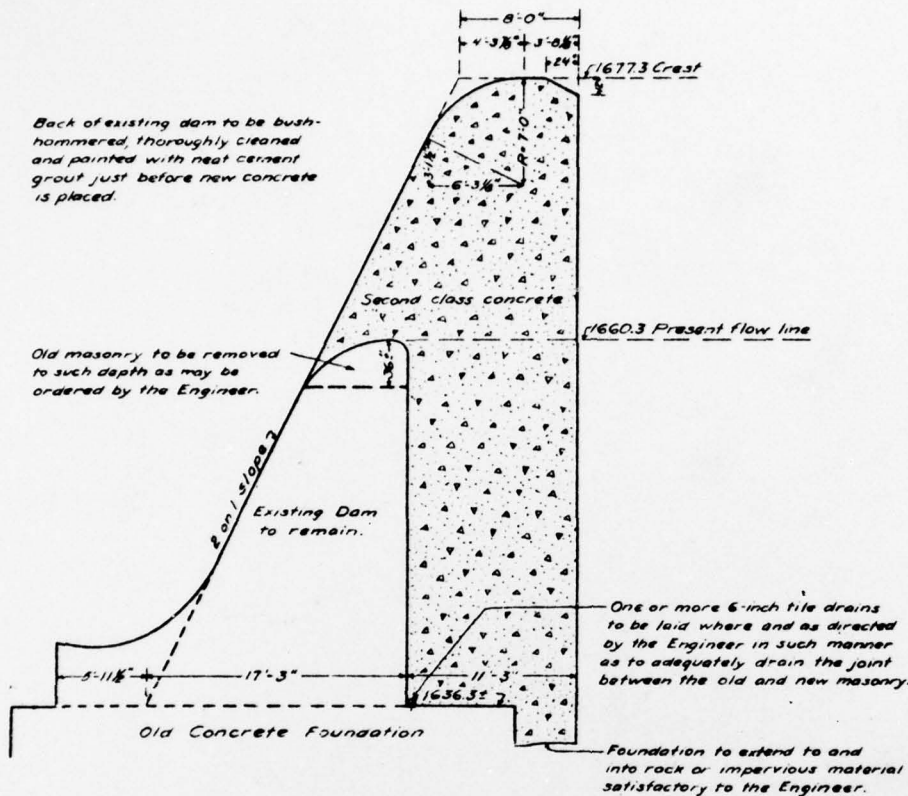
Approved: *[Signature]*
President
[Signature]
Secretary

FIGURE 3
STATE OF NEW YORK
BLACK RIVER REGULATING DISTRICT
STILLWATER RESERVOIR
PLAN AND PROFILE OF DAM SITE
SCALES INDICATED
SEPTEMBER 26, 1923

Doc. 14-389

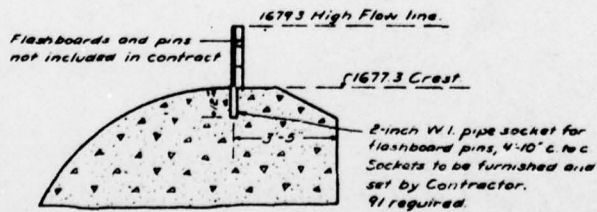
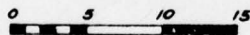
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H
SE



SECTION A-A

SCALE-Feet



FLASHBOARDS

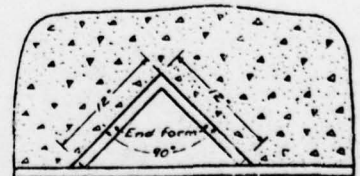
SCALE-Feet



Notes -

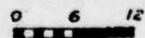
The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer shall be of such elevation and of such dimensions as shall be necessary to provide a proper foundation.

If ordered in writing by the Engineer, one section of the spillway, 40 feet long, to be designated by the Engineer, shall be left at elev 1657.3 until all other work has been completed, and permission to complete the spillway has been given by the Engineer.



KEYWAY

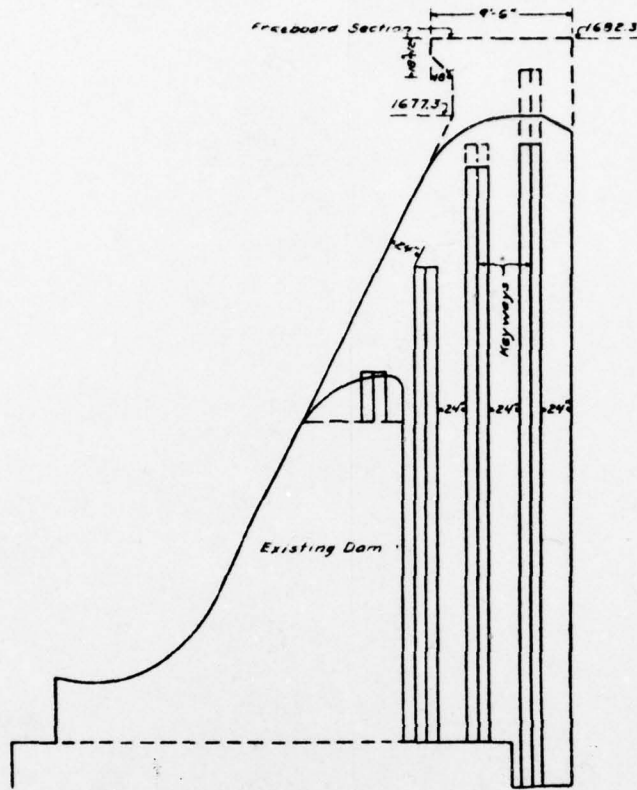
SCALE-INCHES



Design by *William J. Johnson*
Civil Engineer.
Approved by *W. J. Johnson*
Chief Engineer.

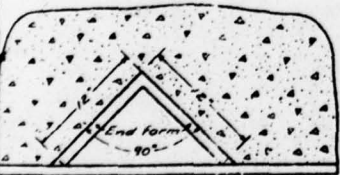
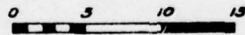
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If ordered in writing by the Engineer, one section of the spillway, 40 feet long, to be designated by the Engineer, shall be left at elev 1657.3 until all other work has been completed, and permission to complete the spillway has been given by the Engineer.



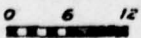
KEYWAYS AT JOINTS

SCALE-Feet



KEYWAY

SCALE-INCHES



Approved: *[Signature]*
 President
 7/1/82

FIGURE 4

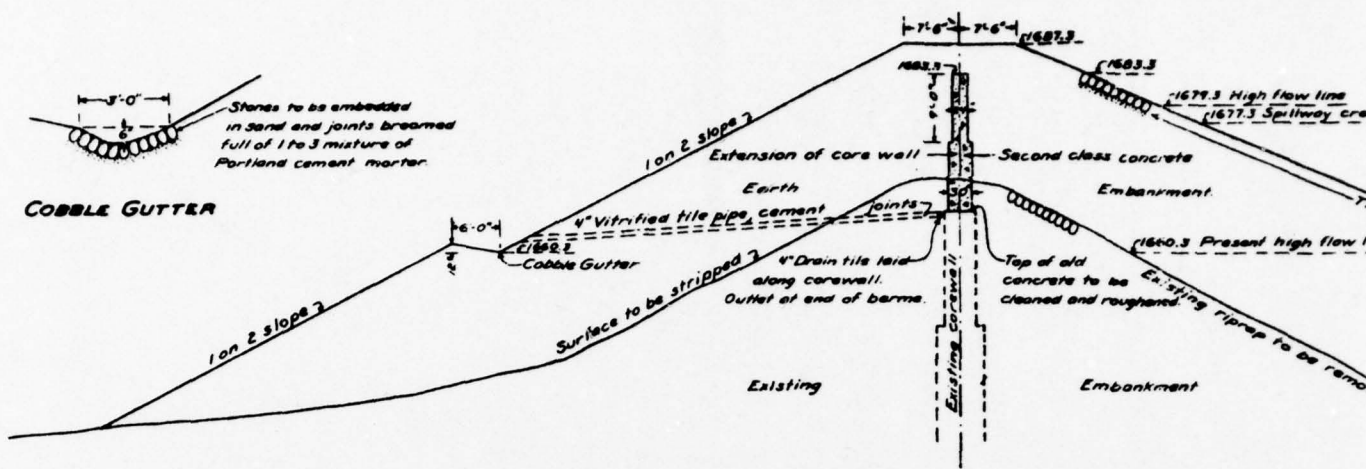
STATE OF NEW YORK
 BLACK RIVER REGULATING DISTRICT
 STILLWATER RESERVOIR
 DETAILS OF SPILLWAY

SCALES INDICATED
 SEPTEMBER 22, 1982

ALC M-340

2

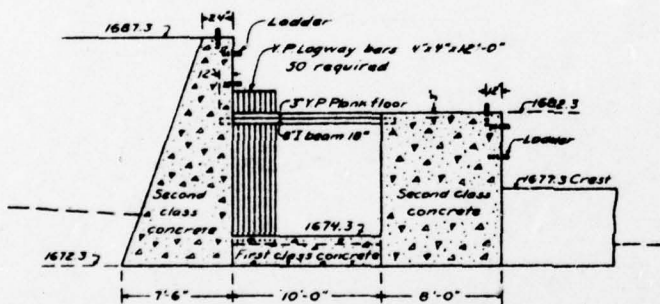
6
SR



SECTION-NORTH DAM

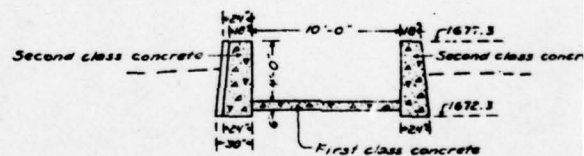
STA. 10+50

SCALE-Feet



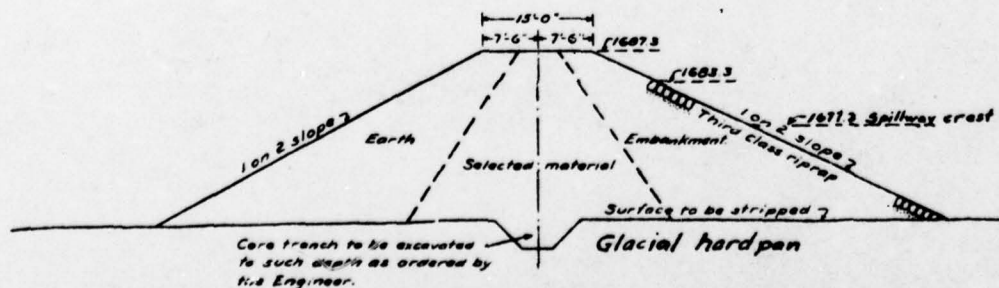
SECTION C-C-LOGWAY

SCALE-Feet



SECTION D-D LOGWAY

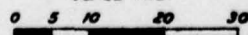
SCALE-Feet



SECTION-SOUTH DAM

STA. 2+50

SCALE-Feet

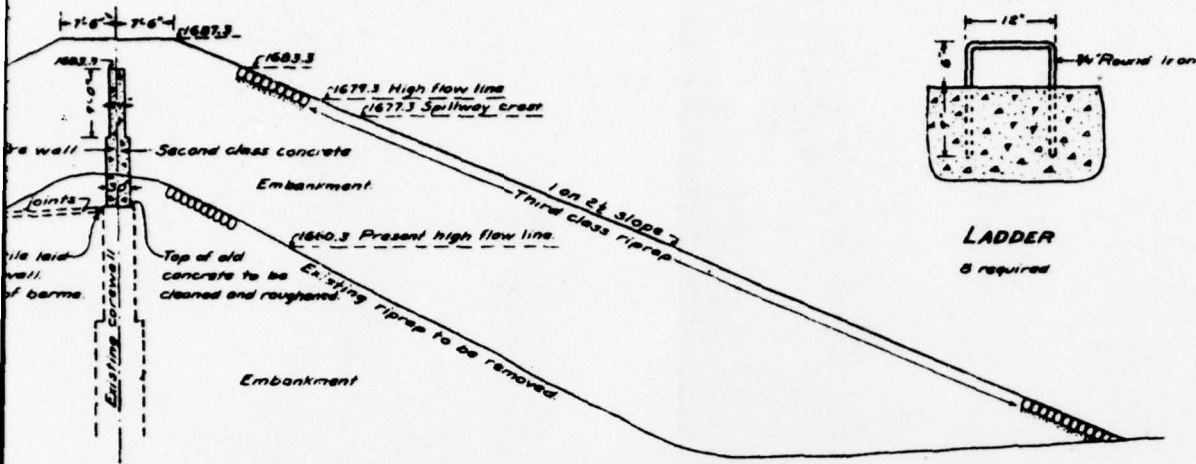


Design by *[Signature]*
Approved by *[Signature]*
Chief Engineer

Notes:-
The bases of the shown or any of of this contract considered as ap only and if order by the Engineer, such elevation an dimensions as sh necessary to pro proper foundati
The north end of shall be extended to such distance deemed necessary Engineer to give security

Approved

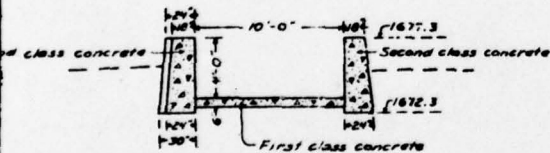
SHEET 6



SECTION-NORTH DAM

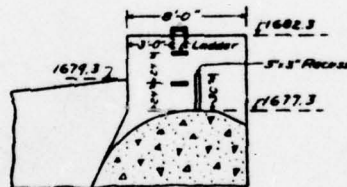
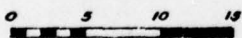
STA. 10+50

SCALE-Feet



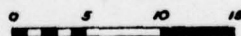
SECTION D-D LOGWAY

SCALE-Feet



ELEVATION LOGWAY BULKHEAD

SCALE-Feet



Notes:-

The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer, shall be of such elevation and of such dimensions as shall be necessary to provide a proper foundation.

The north end of the carewall shall be extended into the bank to such distance as may be deemed necessary by the Engineer to give proper security.

Approved: *[Signature]*
[Signature]
[Signature]

FIGURE 5

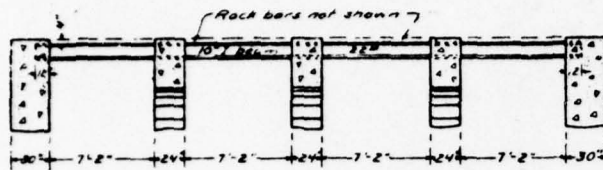
STATE OF NEW YORK
 BLACK RIVER REGULATING DISTRICT

STILLWATER RESERVOIR
 DETAILS OF LOGWAY AND DAMS

SCALES INDICATED
 SEPTEMBER 22, 1923.

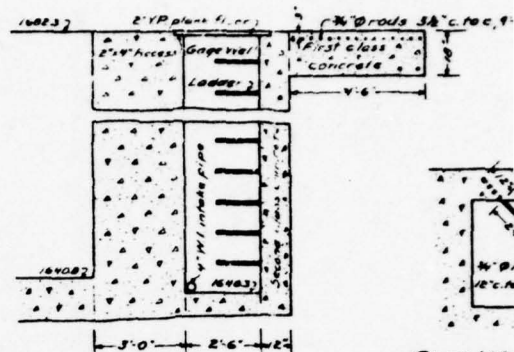
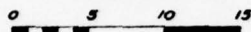
Att. 14-348

7
SE



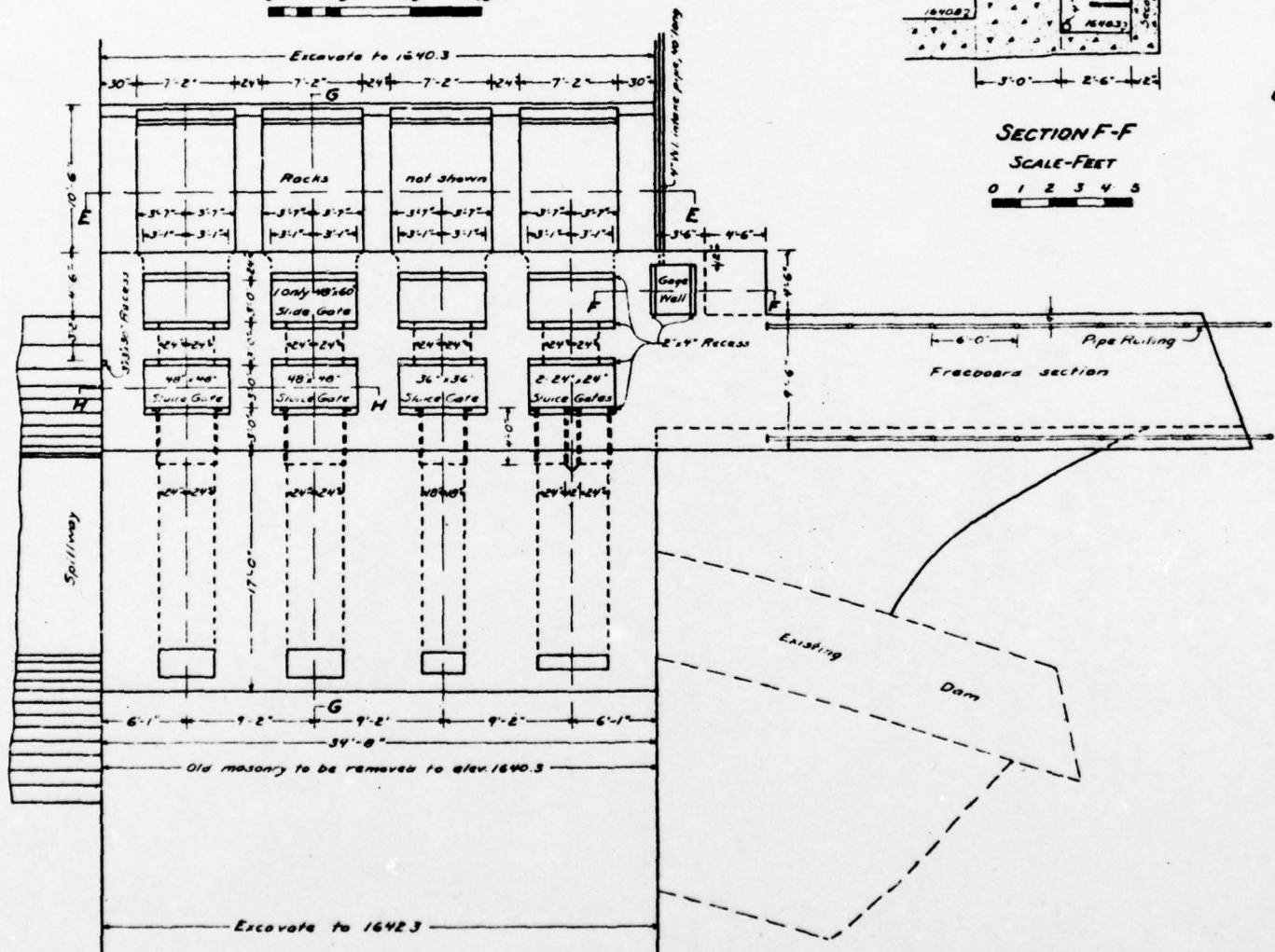
SECTION E-E

SCALE-Feet



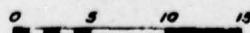
SECTION F-F

SCALE-Feet



PLAN

SCALE-Feet

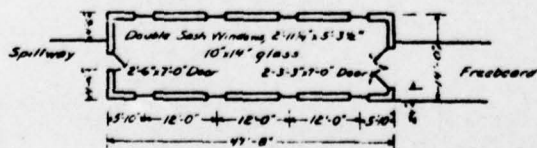
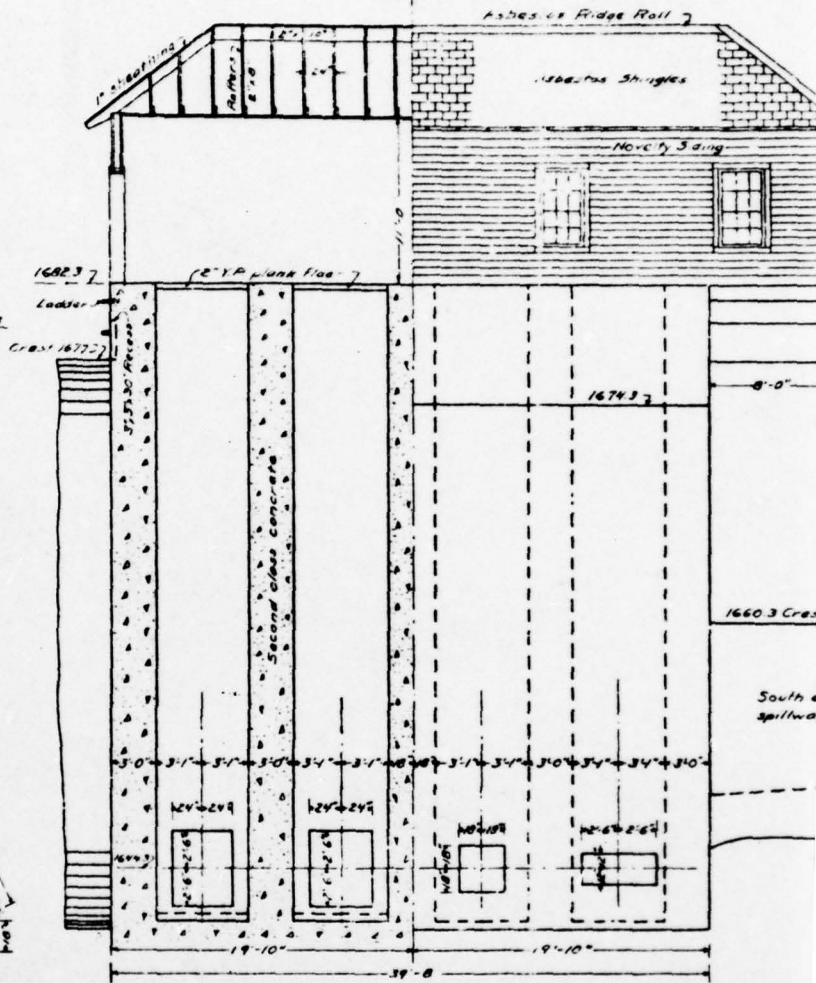
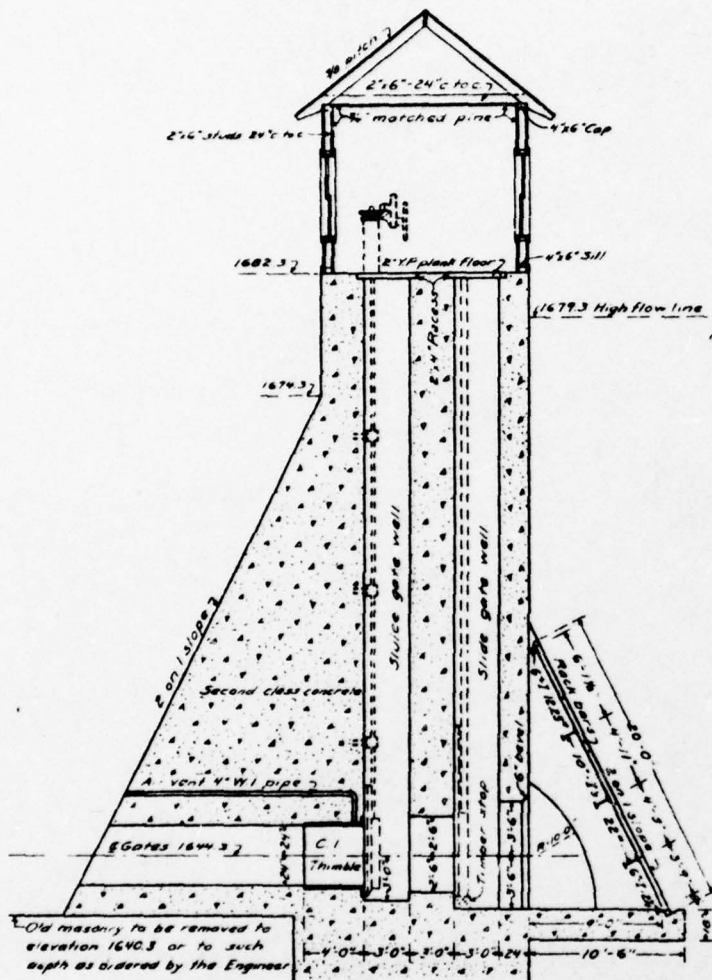


Notes -

The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer, shall be of such elevation and of such dimensions as shall be necessary to provide proper foundation.

Design by *Harold Johnson*
Asst. Engineer
Approved by *Carl Klingberg*
Chief Engineer

Approved by *W. L. Johnson*
W. L. Johnson
Chief Engineer



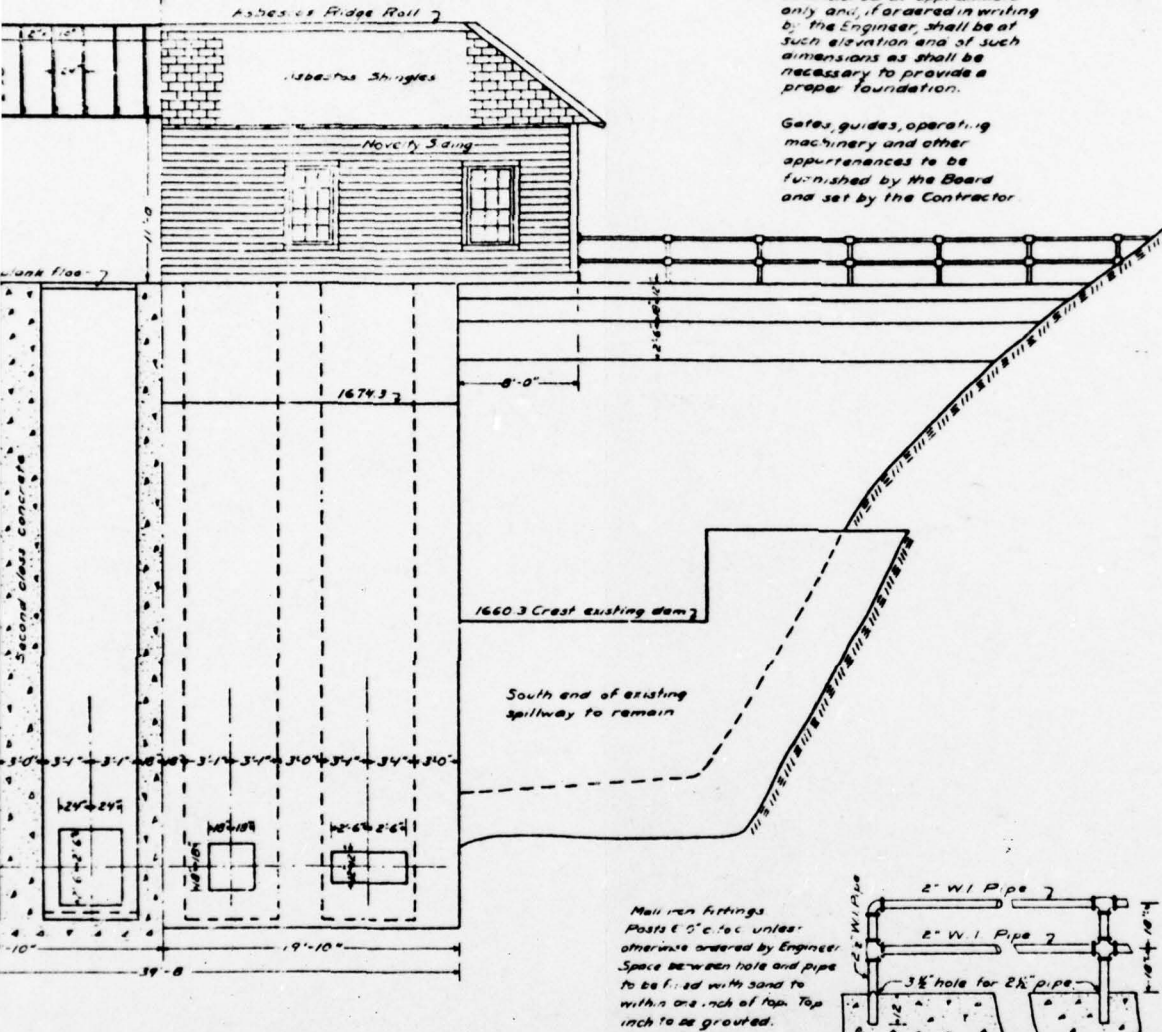
Design by *Harold J. Johnson*
 Asst. Engineer
 Approved by *St. C. Callahan*
 Chief Engineer

Approved by *Walter A. [Signature]*
 Chief Engineer
 Date *10/10*

Notes -

The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer, shall be of such elevation and of such dimensions as shall be necessary to provide a proper foundation.

Gates, guides, operating machinery and other appurtenances to be furnished by the Board and set by the Contractor.

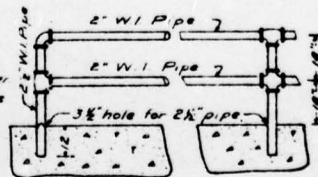


SECTION H-H HALF ELEVATION

SCALE-Feet

0 5 10 15

Man iron fittings
Posts 6" c/c unless
otherwise ordered by Engineer.
Space between hole and pipe
to be filled with sand to
within one inch of top. Top
inch to be grouted.



PIPE RAILING

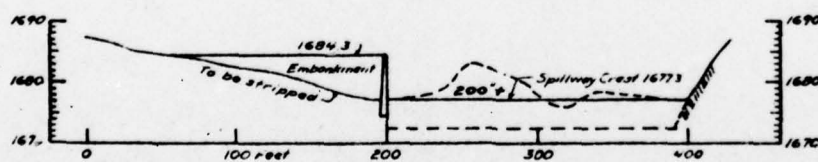
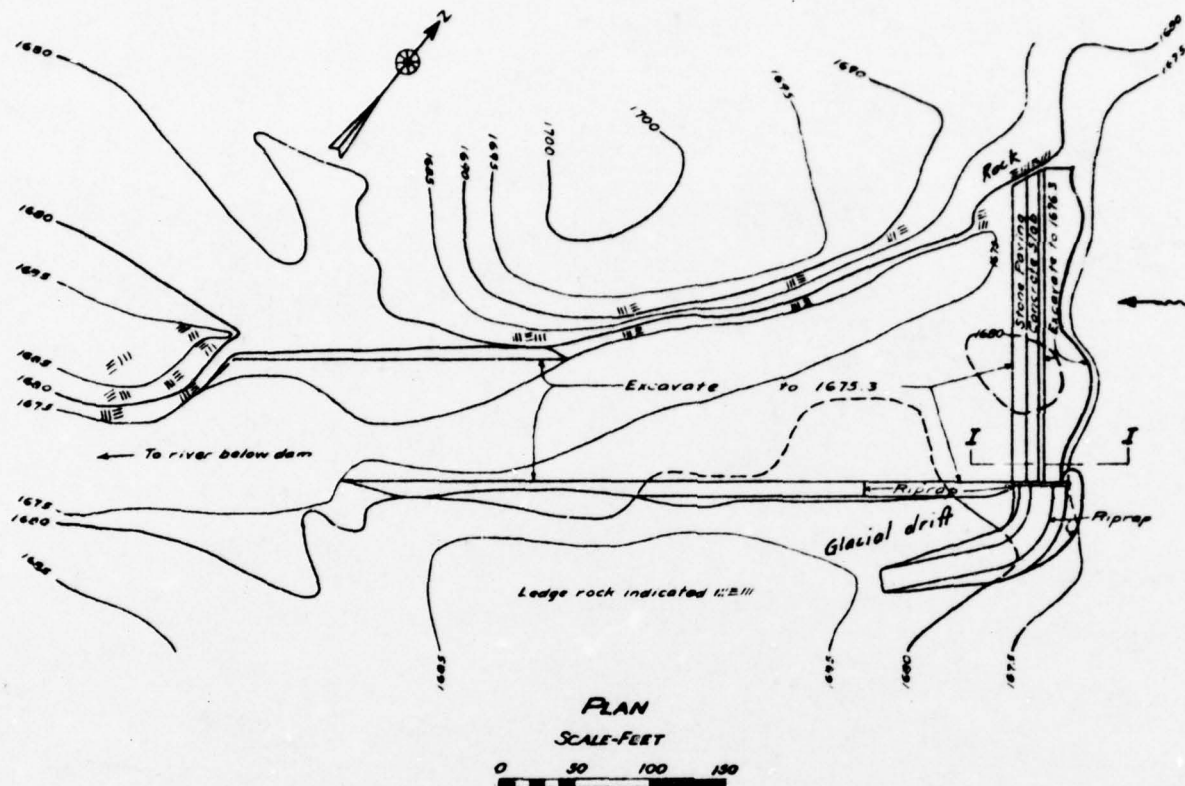
FIGURE 7

STATE OF NEW YORK
BLACK RIVER REGULATING DISTRICT
STILLWATER RESERVOIR
DETAILS OF OUTLET WORKS

SCALES INDICATED
SEPTEMBER 22, 1923

ACC. M. 344

Approved: *Walter C. Brown*
President
10/3/23



PROFILE
(Looking downstream)

Note :- The bases of the structures shown on any of the plans of this contract shall be considered as approximate only and, if ordered in writing by the Engineer, shall be at such elevation and of such dimensions as shall be necessary to provide a proper foundation.

Design by Hollis Johnson
Asst. Engineer.
Approved by J. K. Williams
Chief Engineer.

4/12/1908
Wm. D. ...
Richard ...
11/10

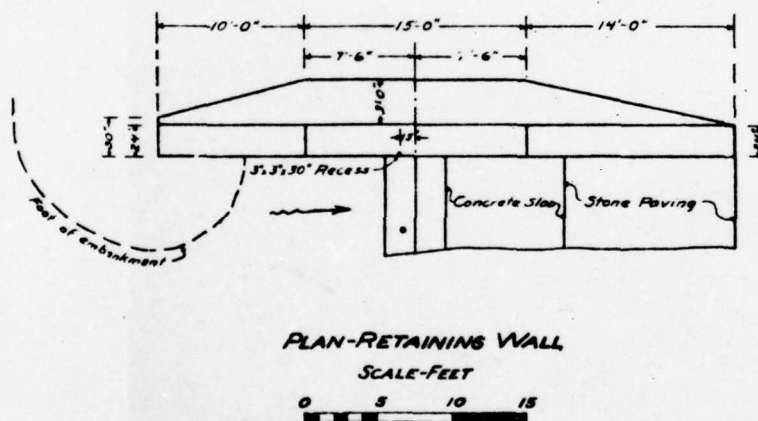
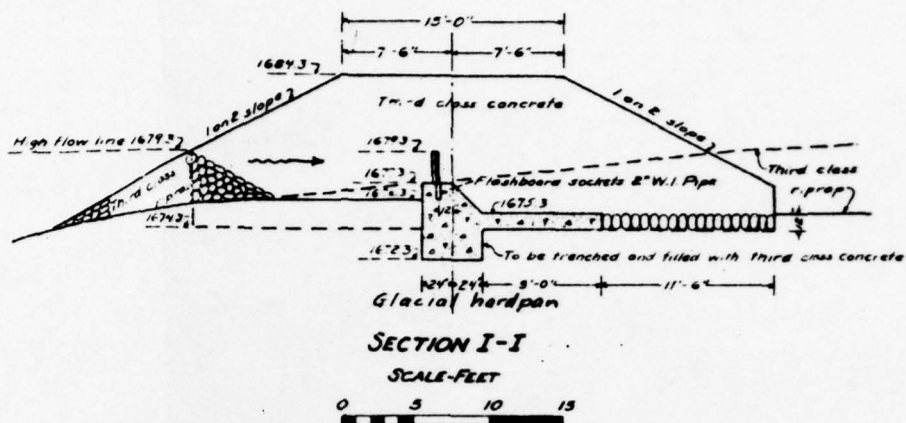
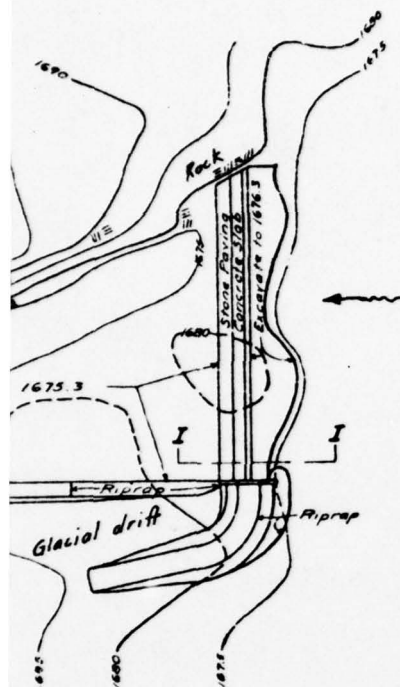


FIGURE 8

STATE OF NEW YORK
BLACK RIVER REGULATING DISTRICT
STILLWATER RESERVOIR
DETAILS OF AUXILIARY SPILLWAY

SCALES INDICATED
SEPTEMBER 28, 1923.

ACC. 14-343

APPROVED
W. H. ...
President
J. H. ...
Secretary

2

APPENDIX

PHOTOGRAPHS

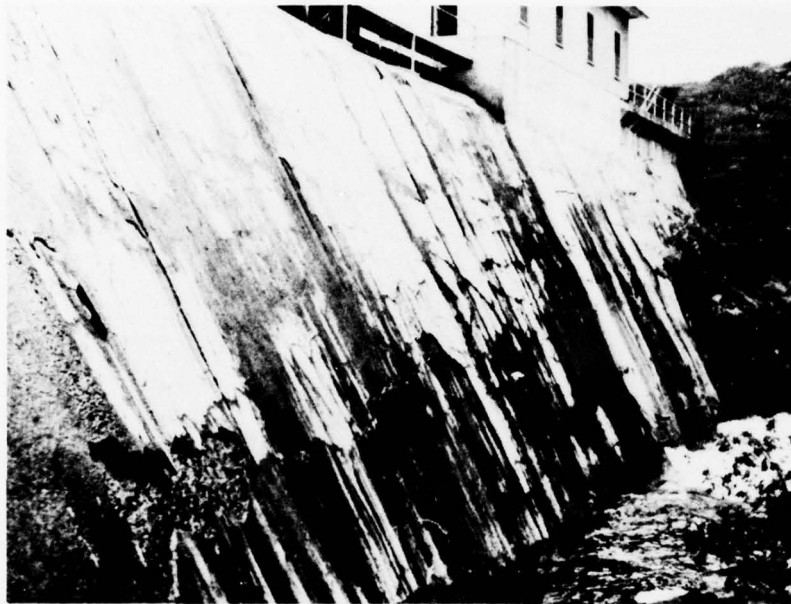
A-1



VIEW OF CONCRETE SPILLWAY AND ROCK OUTCROP



DOWNSTREAM CHANNEL



DOWNSTREAM SLOPE OF SPILLWAY



DOWNSTREAM FACE OF GATE HOUSE



NORTH DAM (UPSTREAM SLOPE) LOOKING NORTH



CREST OF NORTH DAM LOOKING SOUTH

FIELD INSPECTION REPORT

Check List
Visual Inspection
Phase 1

Name Dam Stillwater Reservoir Dam County Herkimer State New York Coordinators Mr. Lee Crosman

Date(s) Inspection June 13, 1978 Weather Intermittent Showers Temperature 50°

Pool Elevation at Time of Inspection 1678.3 M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Mr. J. J. Williams _____
Mr. J. V. Ryan _____
Mr. A. J. Depman _____
Mr. R. E. Horvath _____

Mr. R. E. Horvath _____ Recorder

Accompanied by: Mr. Lee Crosman, Superintendent, Stillwater Reservoir Dam, Hudson River - Black River
Regulating District.

CONCRETE/MASONRY DAMS

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SEEPAGE OR LEAKAGE

STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS

No settlement or seepage was noted at the abutment junctions.

DRAINS

A-7

No drains were noted. Operating personnel could provide no information relative to drains.

WATER PASSAGES

Water passages could not be inspected because of discharge.

FOUNDATION

Not observed.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	<p>A small crack was located in the spillway crest, about 75 feet from the gatehouse. The crack appeared to be superficial.</p> <p>A concrete surface protection which has been applied to the concrete has cracked and separated from the structure in several places.</p>	
STRUCTURAL CRACKING	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT A-8	Vertical and horizontal alignment appear to be good. No noticeable deviations were observed.	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	<p>No relative movement was observed at the joints. The joints on the upstream face of the spillway are open. No deterioration was noted.</p>	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were noted in either of the earth dam embankments.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ADJUTENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No significant deviation in crest alignment was noted in either earth dam.	
RIPRAP FAILURES	None noted.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No settlement was noted at the junctions of the embankments and abutments.	
ANY NOTICEABLE SEEPAGE A-10	Pools of water were observed at about five locations on the downstream slopes of the earth dams. The source of the pools could not be determined. The water was clear and no movement was detected.	
STAFF GAGE AND RECORDER	A reservoir stage recorder is located in the gatehouse.	
DRAINS	None noted.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not observed.	
INTAKE STRUCTURE	Not observed.	
OUTLET STRUCTURE A-11	The protective surface treatment applied to the non-overflow section below the gatehouse is cracked over most of the downstream face.	
OUTLET CHANNEL	The outlet channel is formed in massive natural rock outcrops. No erosion was noted.	
EMERGENCY GATE	An emergency stoplog assembly is located in the gatehouse and can be placed in any of the gatehouse openings. The stoplog assembly appears to be in good condition.	

1

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	The concrete sill appears to be in good condition. A small crack about 75 feet from the gatehouse was noted. However, it does not appear to be structurally significant.	
APPROACH CHANNEL	Not observed.	
DISCHARGE CHANNEL		
BRIDGE AND PIERS	The bridge and supports located along spillway appear to be in good condition. Some minor corrosion was noted on the metalwork.	
GATES AND OPERATION EQUIPMENT	Flashboards are positioned along the spillway crest. They are secured by pins which extend above the concrete crest. Each flashboard is placed and removed manually. Minor leakage was noted occurring in some of the flashboard assemblies.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None Noted.	
OBSERVATION WELLS	Capped pipes (2), in the vertical position, were located along the crest of the north dam. Their function was unknown to operating personnel.	
WEIRS A-13	None Noted.	
PIEZOMETERS	None Noted.	
OTHER	N/A	

RESERVOIR

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

No indications of slope instability were noted in the areas observed.

SEDIMENTATION

The degree of sedimentation could not be determined.

DOWNSTREAM CHANNEL

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CONDITION

(OBSTRUCTIONS,
DEBRIS, ETC.)

None Noted.

SLOPES

APPROXIMATE NO. OF HOMES AND POPULATION A-15

No homes are located immediately below Stillwater Reservoir Dam. However, Moshier Dam, a power generating site operated by Niagara Mohawk Power Corporation is about 3½ miles downstream.

HYDROLOGIC AND HYDRAULIC CALCULATIONS

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

NAME OF CLIENT CORPS OF ENGINEERS
PROJECT STILLWATER RESERVOIR

SHEET NO. 1 OF
DATE 5/31/78
COMP. BY DEC
CHECKED BY REH

DRAINAGE AREA (BY PLANIMETER) = 154 SQ. MILES.
DATA SHEETS = 178 SQ MILES ← USE

$L = 28$ MILES $L_{CA} = 10$ MILES

AVERAGE SNYDER COEFFICIENTS

$C_F = .625$ $C_A = 2.0$

$$t_P = C_A (L \times L_{CA})^3 = 2.0 (28 \times 10)^3 = 10.8 \text{ HRS.}$$

$$t_T = t_P / 5.5 = 2.0 \text{ HRS}$$

$$\text{G.H. PMP} = 21''$$

REDUCTION DUE TO PROBABLE MISEN OF BASIN
WITH STORM 150 HOURS IS 11.5%

$$\text{G.H. PMP} = 18.6''$$

DEPTH - AREA - DURATION FOR PMP

$$\text{6 H. PMP} = 18.6'' \times .7 = 13.1''$$

$$12 \text{ H. PMP} = 18.6'' \times .83 = 15.5'' \quad 15.5'' - 13.1'' = 2.4''$$

A-17

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JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 2 OF
DATE 5/31/78
COMP. BY DEC
CHECKED BY REL

NAME OF CLIENT CORPS OF ENGINEERS

PROJECT SHILLWATER RESERVOIR

PMP DISTRIBUTION

TIME (HRS)

RAINFALL

0-2	8.5" (65% 6HR. PMP)
2-4	2.6" (20% 6HR. PMP)
4-6	2.0" (15% 6HR. PMP)
6-8	.8" }
8-10	.8" } 12 HR. PMP - 6HR. PMP
10-12	.8" }

THIRD QUARTILE DISTRIBUTION

TIME (HRS)

RAINFALL

0-2	.8"
2-4	.8"
4-6	2.0"
6-8	8.5"
8-10	2.6"
10-12	.8"

A-18

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SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DAM	4	REH	6/6/78	333.023

Checked: DGC

STAGE - DISCHARGE

DISCHARGE - 4 GATES

Gate 1	5' x 4'	INV @ 1641.8	r=1.11
Gate 2	5' x 4'	INV @ 1641.8	r=1.11
Gate 3	3' x 3'	INV @ 1642.8	r=.75
Gate 4	5' x 2'	INV @ 1643.3	r=.71

$$\begin{aligned}
 \text{Length of water passage through dam} \\
 &= 14' + \frac{1}{2} (1674.3 - 1641.8) \\
 &= 14' + 16.25' = 30.25'
 \end{aligned}$$

For Discharge through gates, Assume

- pressure flow
- tailwater at top elev of discharge conduit
- common invert at elev 1641.8
- common hydraulic radius = .9
- $\eta = .015$
- $L = 30'$
- $K_e = 1.0$
- Area = 59th (total of four gates)

SUBJECT	SHEET	BY	DATE	JOB NO.
STILLWATER RESERVOIR DAM	5	PEH	6/6/78	

Checked DBC

$$H = \left(1 + K_e + \frac{29 n^2 L}{1.49} \right) \frac{V^2}{2g}$$

$$H = (1 + 1 + .22) \frac{V^2}{2g}$$

$$H = 2.22 \frac{V^2}{2g}$$

$$V = \sqrt{29 H}$$

$$\text{Assume } H = \text{EL} - 1646.8$$

$$Q = AV = 59V$$

- Assume legumy closed

- Spillway Discharges $Q = CLH^{3/2}$

Assume C for 245 spillway = 3.5

Assume C for 200' spillway = 2.6

$$Q = (3.5 \times 245 + 2.6 \times 200) H^{3/2} = 1377.5 H^{3/2}$$

$$\text{Use } Q = 1378 H^{3/2}$$

- Discharge - Overtopping (crest elevation = 1687.3)

Length = 1000 feet

Assume C = 3

$$\therefore Q = 3(1000) H^{3/2} = 3000 H^{3/2}$$

* Assume non-overflow section of gravity dam to be ineffective for flow area.

SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DAM	6	REH	6/16/78	

Elev — Discharge (cfs)

<u>Elev</u>	<u>Q_{gates}</u>	<u>Q_{spillways}</u>	<u>Q_{overtopping}</u>	<u>Q_{total}</u>
1679.3	0 *	0	0	0
1681.3	1864	3886	0	5760
1683.3	1918	11020	0	12938
1685.3	1971	20245	0	22216
1687.3	2024	31169	0	33193
1689.3	2071	43560	8485	54116
1691.3	2119	57261	24000	83380

* Assume gates are opened at the beginning of PMF

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Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 6A OF

DATE 6/16/78

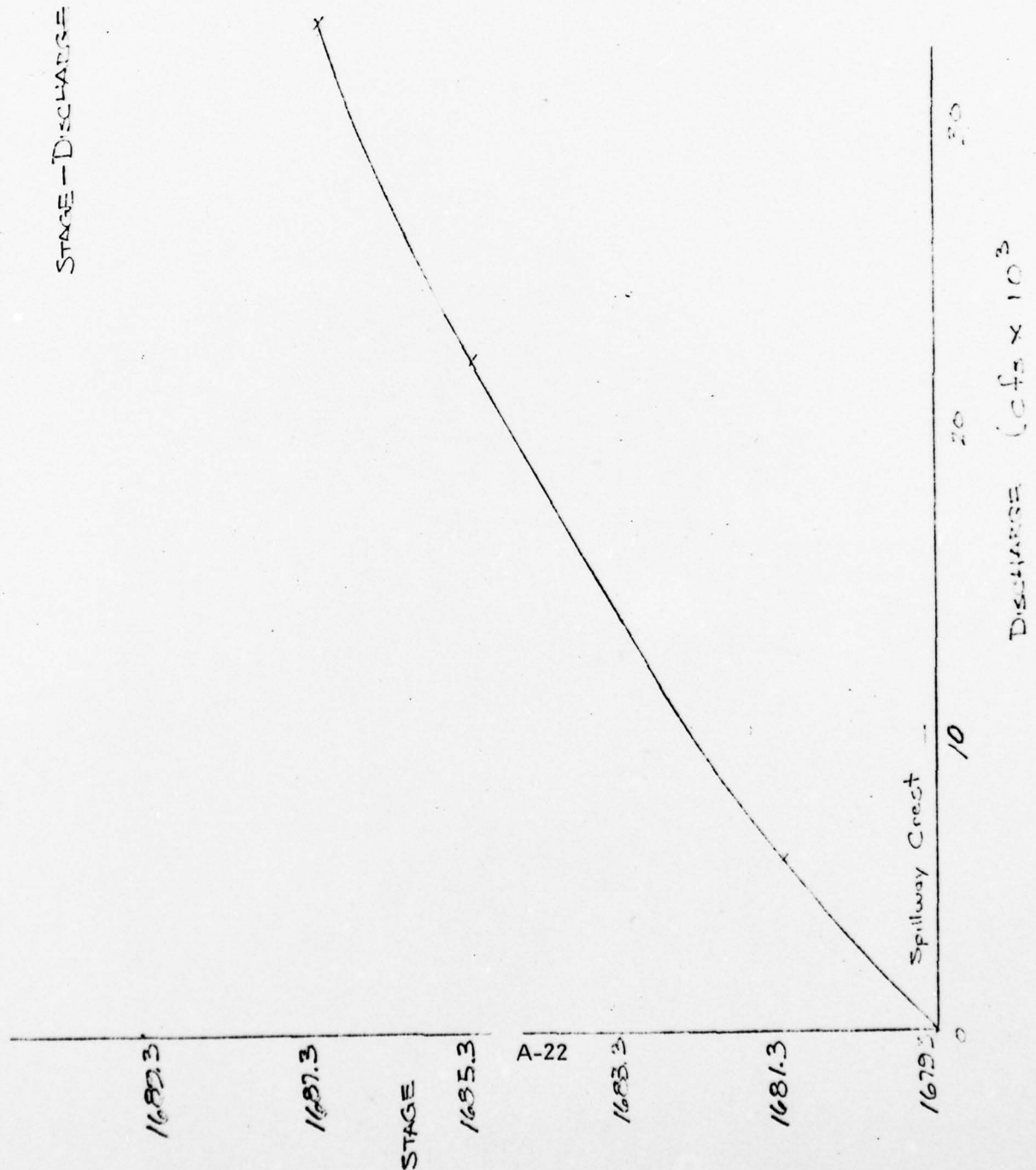
COMP. BY RPH

NAME OF CLIENT NYSD&C

PROJECT STILLWATER RESERVOIR DAM

CHECKED BY

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SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DRAIN	7	REH	6/18/78	

Checked DBC

STAGE - STORAGE

Surface area @ Spilling Crest = 6720 A_c (Elev 1679.3)

Surface area @ Elev 1700 = 12698 A_c

Assume area varies linearly with stage

$$\therefore 5977.6 / 20.7 = 288.8 \text{ A}_c / \text{Ft}$$

$$A = 288.8 d + 6720 \quad d = 0 @ 1679.3$$

$$S = 144.4 d^2 + 6720 d \quad (\text{above Spilling Crest})$$

From Water Reservoir Ditch to N	Stage	A _c	Inc St. (A _c Ft)	Accum St. (A _c Ft)	
					(A _c Ft) Accum Storage
	1658		13866	13866	
	1660		4982	18848	
	1665		16001	34849	
	1670		20959	55808	
	1675		25826	81634	
	1680		31222	112856	0 @ 1679.3
	1681.3	7298		122,502	14018
	1683.3	7875		137,675	29190
	1685.3	8453		154,002	45518
	1687.3	9030		171,487	63002
	1689.3	9608		190,125	81640
	1691.3	10186		209,919	101434

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Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 24 OF

DATE 6/12/78

NAME OF CLIENT NYSDEC

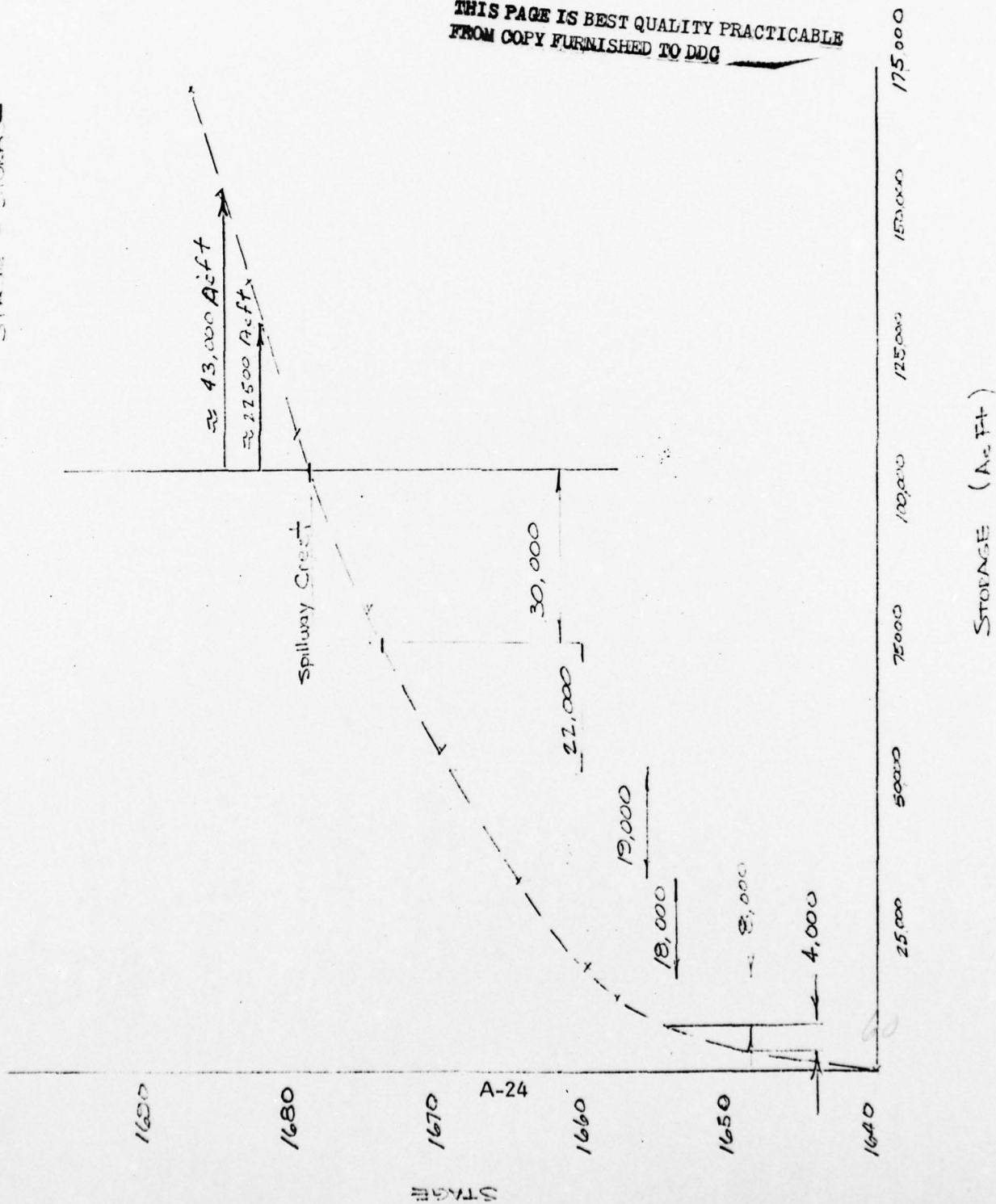
COMP. BY PHL

PROJECT STILLWATER RESERVOIR

CHECKED BY DBC

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STAGE - STORAGE



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DATE 8/28/78

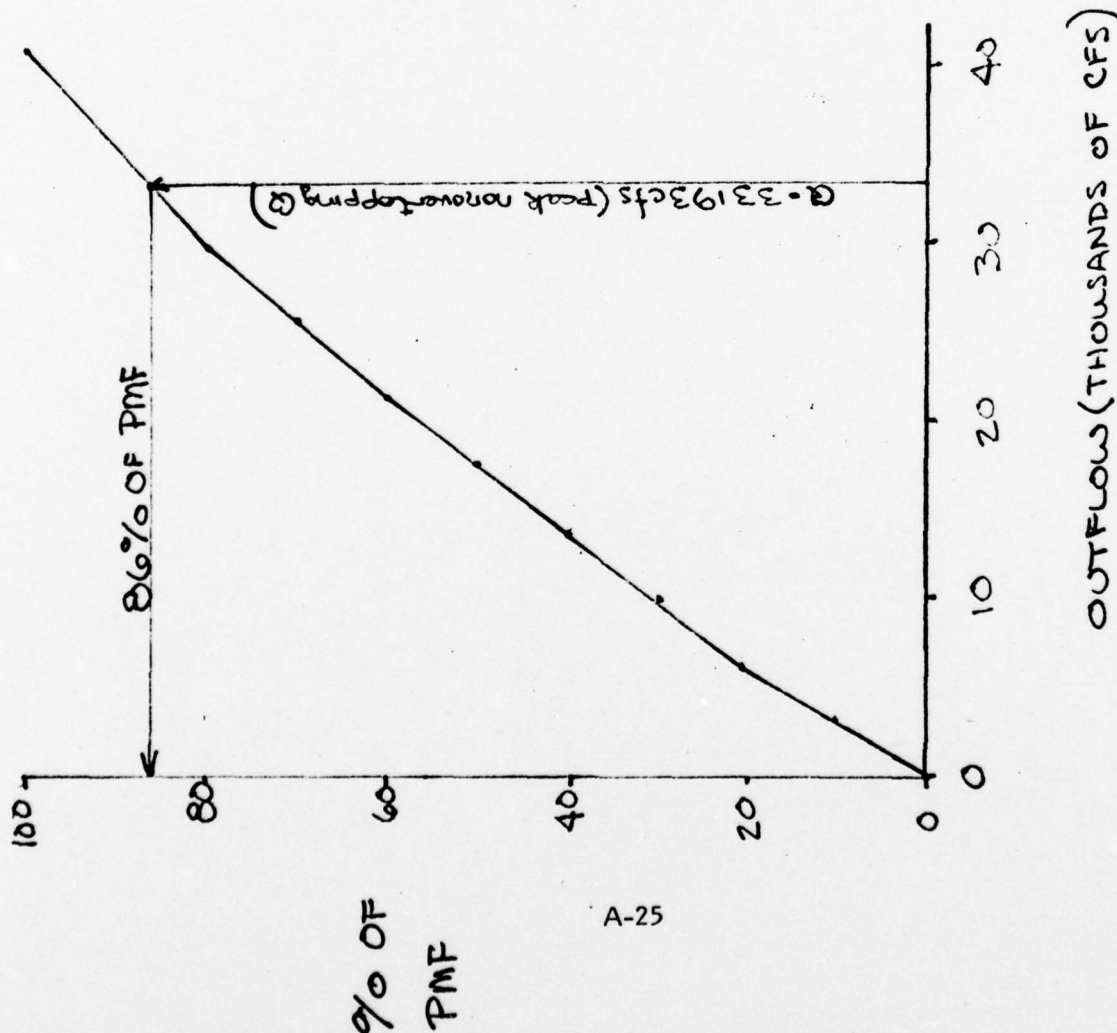
NAME OF CLIENT NYSDEC

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PROJECT Stillwater Reservoir Dam

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SUBJECT	SHEET	BY	DATE	JOB NO.
STILLWATER RESERVOIR DAM	8	REL	7/10/78	

Checked DBC

DRAINAGE ANALYSIS

Assumptions

- water surface at spillway crest
- gates fully open
- inflow = 0

Elev	Head (ft)	Vel (fps)	Q (cfs)
1679.3	32.5	30.7	1811
1674.3	27.5	28.2	1664
1669.3	22.5	25.5	1505
1664.3	17.5	22.5	1328
1659.3	12.5	19.0	1121
1654.3	7.5	14.7	867
1649.3	2.5	8.5	502
1641.8	0	0	0

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SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER PESTHICIDE TANK	5	TSK	7/10/72	

Checked DBC
(CE)

Elev	Elev	Storage (CF)	Avg Discharge	Time (hrs)
1679.3	1674.2	1307 x 10 ⁶	1738	208
1674.3	1669.3	958 x 10 ⁶	1585	168
1669.3	1664.3	828 x 10 ⁶	1417	162
1664.3	1659.3	784 x 10 ⁶	1225	178
1659.3	1654.3	348 x 10 ⁶	994	97
1654.3	1649.3	174 x 10 ⁶	685	70
1649.3	1641.8	174 x 10 ⁶	251	122

or 45 days

Calculations result in a minimum drawdown time of about 45 days. No consideration was given to downstream constraints such as safe discharge velocities and/or flows.

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 HEC-1 VERSION DATED JAN 1973
 UPDATED AUG 74
 CHANGE NO. 01

PMF ROUTING-CREST EL 1579.3
 STILLWATER RESERVOIR DAM
 O. BRIEN + GERE - JUSTIN + COURTNEY DIV

JOB SPECIFICATION
 NO NHQ NMIN IOAY THO THIN METRC IPLT IPRT INSTAN
 44 2 0 1 0 0 0 0 2 0
 JOPER NMT
 5 0

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= .10 .20 .30 .40 .50 .60 .70 .80 .90 1.00
 NPLAN= 1 NRTIO= 3 LRTIO= 1

SUB-AREA RUNOFF COMPUTATION

1STAQ ICOMP IEGON ITARE JPLI JPRT INAME
 1 0 0 0 0 1 0 0

HYDROGRAPH DATA
 INYDQ IJHG TAREA SNAP TQSDA TRSPC RATIO ISNOW ISAME LOCAL
 0 1 178.00 0.00 0.00 0.00 0.00 0.000 0 0 0

PRECIP DATA
 NP STORM DAJ DAK
 6 0.00 0.00 0.00
 PRECIP PATTERN
 2.60 .80

LOSS DATA
 STOKS OLTKR RTIOL FRATH STPKS RTIOX STIRL CNSTL ALSMK RTIMP
 0.00 0.00 1.00 0.00 0.00 1.00 0.00 .10 0.00 0.00

UNIT HYDROGRAPH DATA
 TP= 10.40 CPE= .63 NTA= 0

RECESSION DATA
 STRIO= 0.00 ORCSN= 0.00 RTIO= 1.00
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TO ARE TO= 6.31 AND R= 4.90 INTERVALS

UNIT HYDROGRAPH 30 END-OF-PERIOD COORDINATES, LAG= 13.78 HOURS, CPE= .53 VOL= 1.00
 475. 1710. 3402. 5043. 6283. 5782. 6170. 5107. 4161. 3390.
 2752. 2250. 1433. 1433. 1217. 931. 807. 654. 516. 437.
 355. 290. 236. 192. 157. 128. 104. 85. 69. 56.

END-OF-PERIOD FLOW
 TIME RAIN EXCS COMP Q
 1 2 0 .80 .60 285.
 172

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HYDROGRAPH AT STA		1 FOR PLAN 1, RHO 1		TOTAL VOLUME	
PEAK	6-HOUR	24-HOUR	72-HOUR	72-HOUR	TOTAL VOLUME
90.20.	95.07.	57.04.	2270.4.	917.56.	917.56.
	4.5%	11.98	14.24		
	43067.	115720.	135170.		
SUM	15.50	14.30	91756.		

HYDROGRAPH AT STA		1 FOR PLAN 1, RHO 1		TOTAL VOLUME	
PEAK	6-HOUR	24-HOUR	72-HOUR	72-HOUR	TOTAL VOLUME
90.20.	95.07.	57.04.	2270.4.	917.56.	917.56.
	4.5%	11.98	14.24		
	43067.	115720.	135170.		
SUM	15.50	14.30	91756.		

HYDROGRAPH AT STA		1 FOR PLAN 1, RHO 1		TOTAL VOLUME	
PEAK	6-HOUR	24-HOUR	72-HOUR	72-HOUR	TOTAL VOLUME
90.20.	95.07.	57.04.	2270.4.	917.56.	917.56.
	4.5%	11.98	14.24		
	43067.	115720.	135170.		
SUM	15.50	14.30	91756.		

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259.	188.	137.	35.	7.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3									
85.	397.	1180.	1644.	9533.	14884.	21127.	25565.	27126.	25436.
21719.	17881.	14582.	11880.	9578.	7885.	6824.	5233.	4264.	3474.
2430.	2305.	1478.	1530.	1247.	1016.	827.	676.	549.	447.
356.	282.	205.	53.	10.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4									
116.	529.	1574.	4859.	11377.	13846.	28170.	34087.	36158.	33914.
24959.	23841.	13442.	15840.	12904.	10513.	8565.	6978.	5685.	4631.
3773.	3074.	2504.	2040.	1662.	1354.	1193.	899.	732.	597.
475.	376.	273.	71.	13.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5									
142.	661.	1367.	6073.	14221.	24807.	35212.	42509.	45210.	42393.
36199.	23801.	24303.	14739.	16130.	13141.	10706.	9722.	7106.	5769.
4715.	3842.	3130.	2550.	2078.	1693.	1379.	1124.	915.	746.
594.	470.	362.	88.	17.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 6									
171.	794.	2360.	7288.	17055.	23769.	42255.	51130.	54252.	50871.
4353.	35761.	23104.	21759.	13357.	15770.	12847.	10667.	8527.	6947.
5660.	4611.	3757.	3040.	2493.	2031.	1655.	1384.	1098.	895.
713.	564.	410.	106.	20.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 7									
193.	926.	2754.	8503.	13809.	34730.	42307.	50652.	63294.	59350.
50673.	41721.	34026.	27714.	22533.	14339.	14980.	12711.	9948.	8105.
6603.	5379.	4383.	3570.	2404.	2370.	1931.	1573.	1291.	1044.
931.	658.	478.	173.	24.	0.	0.	0.	0.	0.

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228.	1058.	3147.	9717.	22754.	34632.	56340.	69174.	72336.	11370.	14664.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0
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1086. 2893. 2220. 2548. 2383. 2042. 1956. 1919. 1700.
1589. 1486. 1389. 1298. 1213. 1134. 1050. 991.

STOP

140. 156. 230. 472. 1090. 2267. 4039. 6254. 10899.
12701. 13982. 14796. 15270. 15372. 15292. 15044. 14676. 13703.
13145. 12560. 11363. 11364. 10770. 10188. 9821. 9073. 8041.
7553. 7099. 6662. 6241. 5837. 5456. 5100. 4767. 4165.
3893. 3639. 3401. 3179. 2972. 2774. 2596. 2427.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
6362. 6326. 5842. 3924. 150129.
3FS INCHES .33 1.22 2.46
AC-FT 3139. 11593. 23762. 24827.

STATION 2. PLAN 1, RTIO 3

85. 96. 141. 209. 658. 1384. 2473. 3476. 6820.
8049. 8975. 9824. 9802. 9879. 9796. 9396. 8965. 8580.
8169. 7745. 7317. 6892. 6475. 6071. 5692. 5369. 4761.
4477. 4205. 3947. 3697. 3458. 3233. 3022. 2824. 2468.
2307. 2156. 2015. 1884. 1761. 1646. 1518. 1434.

STOP

209. 234. 345. 786. 1635. 3401. 6058. 9395. 16336.
19001. 20864. 22018. 22607. 22762. 22587. 22167. 21568. 20032.
19169. 18278. 17379. 16487. 15611. 14761. 13942. 13152. 11662.
10365. 10300. 9656. 9056. 8470. 7918. 7401. 6918. 6044.
5543. 5281. 4936. 4614. 4312. 4031. 3768. 3522.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
9479. 9326. 9036. 5915. 225885.
3FS INCHES .51 1.89 3.71
AC-FT 4875. 17932. 35214. 37356.

STATION 2. PLAN 1, RTIO 4

114. 128. 188. 386. 890. 1851. 3298. 5115. 9384.
11053. 12215. 12928. 13349. 13441. 13286. 12950. 12556. 11560.
11004. 10470. 9851. 9278. 8716. 8170. 7645. 7142. 6209.
5780. 5427. 5034. 4773. 4454. 4173. 3901. 3646. 3185.
2978. 2783. 2602. 2432. 2273. 2125. 1946. 1856.

STOP

279. 312. 460. 944. 2191. 4534. 8077. 12527. 21723.
25230. 27871. 29170. 29914. 30075. 29802. 29210. 28387. 26296.
25125. 23320. 22705. 21499. 20318. 19172. 18058. 17012. 15052.
14143. 13293. 12477. 11690. 10934. 10221. 9554. 8930. 7802.
7293. 6817. 6372. 5956. 5567. 5204. 4864. 4546.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
13441. 13359. 12238. 7023. 302053.
3FS INCHES .70 2.56 4.97
AC-FT 6629. 24286. 47169. 49952.

STATION 2. PLAN 1, RTIO 5

142. 159. 235. 482. 1113. 2314. 4122. 6494. 11935.
14204. 15890. 16892. 17354. 17409. 17160. 16631. 16065. 14536.
13704. 12871. 12160. 11455. 10763. 10091. 9444. 8824. 7673.
7143. 6642. 6170. 5725. 5355. 5006. 4679. 4373. 3821.
3572. 3338. 3121. 2917. 2726. 2548. 2392. 2277.

STOP

70. 300. 577. 1100. 2726. 6668. 18866. 29601. 27083.
142. 159. 235. 482. 1113. 2314. 4122. 6494. 11935.
14204. 15890. 16892. 17354. 17409. 17160. 16631. 16065. 14536.
13704. 12871. 12160. 11455. 10763. 10091. 9444. 8824. 7673.
7143. 6642. 6170. 5725. 5355. 5006. 4679. 4373. 3821.

DATE	TIME	PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
3ES	17009.	17009.	17009.	15676.	9960.	37909.	37909.
INCHES			.90	3.29	6.25		6.60
AC-FT			8597.	31109.	59294.		65662.

[illegible]

	419.	459.	590.	1416.	3271.	6802.	12116.	18765.	28876.	32405.
37513.	40381.	43006.	43901.	43306.	43342.	43349.	42295.	40917.	39322.	37592.
35791.	33567.	32156.	30386.	28670.	27012.	27012.	25412.	23879.	22418.	21032.
19720.	10860.	17811.	16193.	15123.	14136.	14136.	13215.	12352.	11546.	10792.
19087.	9429.	8813.	7700.	6238.	7713.	7713.	6728.	6289.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	21321.	21200.	19203.	12014.	456185.
TUCHES		1.11	4.01	7.53	7.95
AC-FI		10518.	30100.	71523.	75441.

[illegible][illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
25	25699.	25302.	22778.	14084.	533839.
26		1.32	4.76	8.83	9.30
27		12553.	45203.	83956.	88283.

STATION	2, PLAN 1, PTIN 8	
228.	376.	10931.
255.	771.	6729.
27520.	2366A.	2400A.
24753.	23175.	1496.
22370.	19583.	6831.
10783.	9321.	3314.
10032.	8682.	3173.
4757.	4458.	3394.
5089.	496.	3631.
		15882.
		25366.
		17418.
		5836.
		20746.
		23499.
		1579.
		5444.

	STOP			
55A.	625.	1990.	9069.	16143.
49559.	53967.	57410.	56300.	54743.
45764.	43314.	38511.	36217.	34020.
23083.	21591.	20163.	19402.	17533.
12465.	11651.	10179.	9515.	9996.
				8313.
				7770.
				15272.
				14268.
				28097.
				50566.
				33370.
				24374.
				42927.
				48198.
				26334.
				13335.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
JFS	29689	29451	26418	16184	61187
TWO-ES		1.54	5.52	10.14	10.66
		101182

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27652.	25768.	23914.	22124.	20555.	19049.	17616.	16260.	14984.	13789.
12714.	11832.	10998.	10198.	9434.	8721.	8061.	7451.	6887.	6366.
5884.	5481.	5125.	4790.	4478.	4185.	3912.	3557.		
STOR									
6981.	781.	1150.	2361.	5451.	11336.	20160.	31149.	42794.	53324.
61413.	66595.	69140.	69748.	69016.	67402.	65241.	62770.	60065.	57155.
54176.	51176.	48222.	45356.	42534.	39948.	37422.	35036.	32791.	30687.
29719.	26866.	25113.	23833.	21828.	20330.	18943.	17561.	16476.	15381.
14368.	13429.	12552.	11733.	10867.	10251.	9592.	8956.		
PEAK									
CFS	40766.	40265.	34395.	20394.	TOTAL VOLUME				
INCHES	2.10	7.19	12.79	13.40					
AC-FT	19976.	64256.	121415.	127210.					

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS								
			.10	.20	.30	.40	.50	.60	.70	.80	1.00
HYDROGRAPH AT	1	1	3042.	19084.	27126.	36168.	45210.	54252.	63294.	72336.	90420.
	2	2	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROUTED TO	1	1	3143.	5362.	9879.	13441.	17409.	21321.	25488.	29688.	40766.
	2	2	0.	0.	0.	0.	0.	0.	0.	0.	0.

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STABILITY ANALYSES

SUBJECT

STILLWATER RESERVOIR DAM

SHEET

1

BY

ZEH

DATE

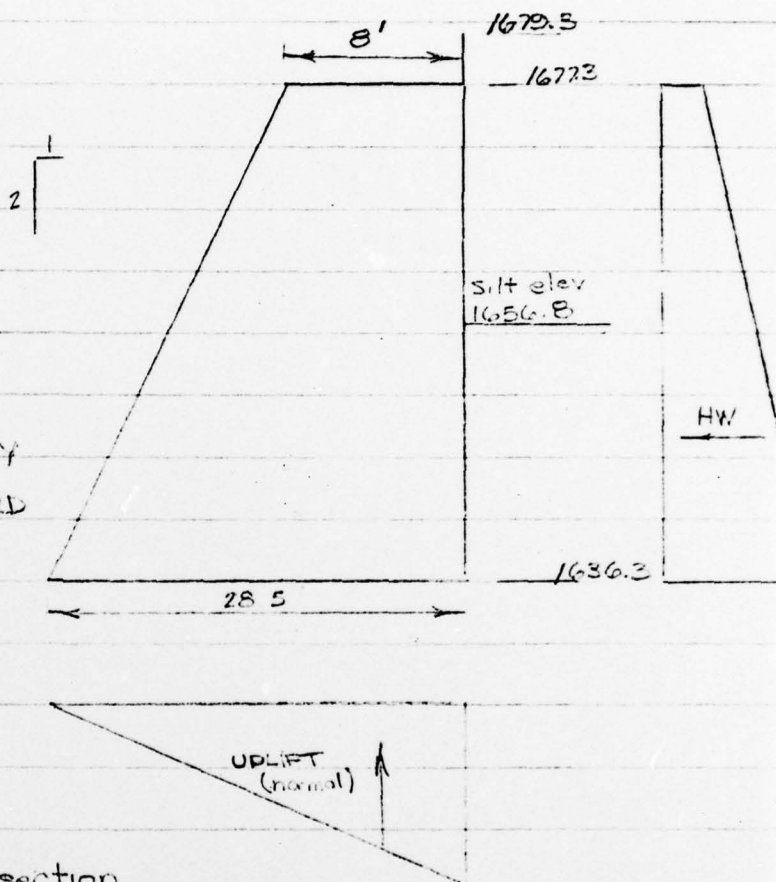
7/3/78

JOB NO

1.0501

SPILLWAY SECTION

section developed from
drawings provided by
NYSDEC and HRBRRD



Assumptions: - gravity section

- unit weight of concrete = 14.1 pcf
- unit weight of silt (wet) = 86 pcf
- internal angle of friction (silt) = 30°
- angle of friction concrete/foundation = 30°
- shear resistance concrete/foundation = 100 psi
- seismic coeff of acceleration = .1g
- T.W elev (PMF) = 1646.3

The effect of negative pressure caused by separation of the nappe from the spillway is beyond the scope of this phase of study and is not considered in the analysis (PMF)

SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DAM	2	R.E.L.	7/3/78	NN505

SPILLWAY STABILITY ANALYSIS - SUMMARY

LOADING CONDITION	SF - AGITATION	SF - SLIDING	BEARING PRESSURES
NORMAL POOL	1.2	7.1	46.7 psi - 14.3 psi (Tension)
EARTHQUAKE	1.0	5.6	60.9 psi - 28.5 psi (Tension)
PMF	1.0	6.0	59.6 psi - 29.2 psi (Tension)

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.....
 NATIONAL DAM INSPECTION PROGRAM - STILLWATER RESERVOIR DAM
 SPILLWAY SECTION - NORMAL POOL 1679.1 W/FLASHROADS

BASE ELEVATION= 1636.30FT. TOP ELEVATION= 1677.30FT. BASE WIDTH= 28.50FT. DENSITY= 146.00PCF
 HEADWATER ELEVATION= 1679.30FT. TAILWATER ELEVATION= 0.00FT. EARTHQUAKE ACCELERATION=.000G (HORIZ) .000G (VERT)
 SILT ELEVATION= 1656.80FT. SILT DENSITY(SUBMERGED)= 86.00PCF SILT PPESSURE COEFFICIENT(K)= .33
 SHEAR STRESS= 100.00PSI SHEAR WIDTH= 28.50FT. FRICTION FACTOR= .58

LOADING	FORCE(KIPS)	ARM(Feet)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	104.80	18.54	1942.91	821.67
HEADWATER	57.56	14.27		726.48
UPLIFT	38.24	19.00		61.12
SILT	6.02	6.03	
			1942.91	1589.27

.....
 NET HORIZONTAL FORCE= 63.58 KIPS
 NET VERTICAL FORCE= 66.56 KIPS
 NET MOMENT= 353.64 KIP-Feet
 X-BAR OF FOUNDATION REACTION= 5.31 FEET
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 8.94 FEET
TENSION AT HEEL OF DAM.....
 FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE.....
 FOUNDATION REACTION PRESSURES.....HEEL= -14.30 PSI.....
 OVERTURNING FACTOR OF SAFETY= 1.22
 SLIDING FACTOR OF SAFETY= .61
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .96
 SLIDING WITH SHEAR FACTOR OF SAFETY= 7.06 (SHEAR ACROSS FULL BASE WIDTH)

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.....
 NATIONAL DAM INSPECTION PROGRAM - STILLWATER RESERVOIR DAM
 SPILLWAY SECTION - NORMAL POOL 1679.3 W/FLASHBOARDS - EARTHQUAKE

BASE ELEVATION= 1636.30FT - TOP ELEVATION= 1677.30FT - BASE WIDTH= 26.50FT - DENSITY= 144.00PCF
 HEADWATER ELEVATION= 1679.30FT - TAILWATER ELEVATION= 0.00FT - EARTHQUAKE ACCELERATION= .100G (HORIZ) .000G (VERT)
 SILT ELEVATION= 1656.80FT - SILT DENSITY(SUBMERGED)= 86.00PCF SILT PRESSURE COEFFICIENT(K)= .33
 SHEAR STRESS= 100.00PSI - SHEAR WIDTH= 26.50FT - FRICTION FACTOR= .58

LOADING	FORCE(KIPS)	ARM(Feet)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	104.80	18.54	1942.91	
HEADWATER	57.56	14.27		821.57
UPLIFT	38.24	19.00		726.44
EARTHQUAKE INDUCED LOADINGS				
.....				
INERTIA-WATER	6.14	17.20		105.58
HORIZONTAL INERTIA-DAM	18.48	18.38		171.46
.....				
SILT	6.02	6.83		41.12
			1942.91	1666.32

NET HORIZONTAL FORCE= 80.20 KIPS
 NET VERTICAL FORCE= 86.56 KIPS
 NET MOMENT= 76.59 KIP-Feet
 X-BAR OF FOUNDATION REACTION= 1.15 FEET
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 13.10 FEET
 FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE..... TENSION AT HEEL OF DAM.....
 FOUNDATION REACTION PRESSURES..... 10E= 60.9% PSI.....HEEL= -24.51 PSI.....
 OVERTURNING FACTOR OF SAFETY= 1.84
 SLIDING FACTOR OF SAFETY= .46
 DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.20
 SLIDING WITH SHEAR FACTOR OF SAFETY= 5.60 (SHEAR ACROSS FULL BASE WIDTH)

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 NATIONAL DAM INSPECTION PROGRAM--STILLWATER RESERVOIR DAM
 SPILLWAY SECTION--PMF

BASE ELEVATION= 1636.30FT. TOP ELEVATION= 1677.30FT. BASE WIDTH= 28.50FT. DENSITY= 144.00PCF
 HEADWATER ELEVATION= 1688.50FT. TAILWATER ELEVATION= 1646.30FT. EARTHQUAKE ACCELERATION= .000G (HORIZ). .000G (VERT)
 SILT ELEVATION= 1656.80FT. SILT DENSITY(SUBMERGED)= 86.00PCF SILT PRESSURE COEFFICIENT(N)= .33
 SHEAR STRESS= 100.00PSI SHEAR WIDTH= 28.50FT. FRICTION FACTOR= .58

LOADING	FORCE(KIPS)	ARM(Feet)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	104.80	18.54	1942.93	1304.18
HEADWATER	81.10	16.08		
TAILWATER	3.12	3.33	10.39	
UPLIFT	55.31	17.47		966.40
SILT	6.02	6.83		41.12
			*****	*****
			1953.32	2311.70

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NET HORIZONTAL FORCE= 84.00 KIPS
 NET VERTICAL FORCE= 49.49 KIPS
 NET MOMENT= -338.38KIP-Feet
 X-BAR OF FOUNDATION REACTION= -7.24 FEET
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 21.49 FEET
 *****FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE*****
 FOUNDATION REACTION PRESSURES*****TOE= 66.62 PSI*****HEEL= -42.50 PSI*****
 OVERTURNING FACTOR OF SAFETY= .84
 SLIDING FACTOR OF SAFETY= .34
 DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.70
 SLIDING WITH SHEAR FACTOR OF SAFETY= 5.23(SHEAR ACROSS FULL BASE WIDTH)
 NUMBER OF STATIONS TO DESCRIBE DAM= 4
 STATION ELEVATION
 .00 1636.30
 21.50 1677.30
 28.50 1677.30
 29.50 1636.30